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IMPACT ASSESSMENT

Accompanying the

proposal for a Regulation of the European Parliament and of the Council

on nature restoration

{COM(2022) 304 final} - {SEC(2022) 256 final} - {SWD(2022) 168 final}

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LIST OF ABBREVIATIONS

BDS2030	Biodiversity Strategy for 2030
BHD	Birds and Habitats Directives
CAP	Common Agricultural Policy
CBD	Convention on Biological Diversity
CFP	Common Fisheries Policy
EEA	European Environment Agency
ELD	Environmental Liability Directive
EMFAF	European Maritime Fisheries and Aquaculture Fund
HD	Habitats Directive
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
LAU	Local Administrative Unit
LULUCF	Land use, land use change and forestry
MAES	Mapping and Assessment of Ecosystems and their Services
MBIs	market-based instruments
MSFD	Marine Strategy Framework Directive
NEC Directive	National Emission reduction Commitments Directive (Directive (EU) 2016/2284)
NGO	Non-governmental organisation
NRP	National Restoration Plan
UNCCD	UN Convention to Combat Desertification
UNFCCC	UN Framework Convention on Climate Change
WFD	Water Framework Directive

GLOSSARY

Term	Meaning or definition
Biodiversity	**Biodiversity** means the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are partand includes diversity within species, between species and of ecosystems.
Cities	Cities means Local Administrative Units where at least 50 % of the population lives in one or more urban centres, in line with the Methodological Manual on Territorial Typologies EUROSTAT 2018[1].
Ecosystem	An ecosystem is a dynamic complex of plant, animal, and microorganism communities and their non-living environment, interacting as a functional unit and includes habitat types, habitats of species and species populations.
Ecosystem condition	Ecosystem condition is the quality of an ecosystem measured in terms of its abiotic and biotic characteristics and defined via key ecosystem attributes.
Ecosystem degradation	Degradation (of an ecosystem) means a level of harmful human impact that results in the loss of biodiversity and simplification or disruption in its composition, structure, and functioning (i.e. condition), and generally leads to a reduction in the flow of ecosystem services.
Favourable reference area	Favourable reference area is the total area of a habitat type in a given biogeographical region or marine region at national level that is considered the minimum necessary to ensure the long-term viability of the habitat type and its species, and all its significant ecological variations in its natural range, and which is composed of the area of the habitat type and, if that area is not sufficient, the area necessary for the re-establishment of the habitat type.
Good (ecosystem) condition	Good condition means a state where the key characteristics of an ecosystem, namely physical, chemical, compositional, structural and functional state, and landscape and seascape characteristics, reflect a high level of ecological integrity, stability and resilience necessary to ensure the long-term maintenance of an ecosystem.
Good ecosystem status	Good ecosystem status means that the ecosystem is in good condition, the areas it covers are stable or increasing and sufficiently large, covering the natural range of the ecosystem.
Green urban space	Green urban space means groupings of 1) green urban areas, including trees and groups of trees, green roofs and green walls, 2) urban forests and 3) herbaceous vegetation associations, as defined according to the mapping guidance of the EU Urban Atlas[2], found within the Local Administrative Units;
Habitat types	Habitat types are sub-units of ecosystems as defined by the European Nature Information System (EUNIS) habitat classification or Annex I of the Habitats Directive (Directive 92/43/EEC).

[1] https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/ks-gq-18-008
[2] https://land.copernicus.eu/user-corner/technical-library/urban_atlas_2012_2018_mapping_guide

Term	Meaning or definition
Habitat of a species	A habitat of a species is an environment defined by specific abiotic and biotic factors, in which the species lives at any stage of its biological cycle.
Indicator	An indicator is a sign that shows the condition or existence of something.
Indicators of ecosystem recovery	Characteristics of an ecosystem that can be used for measuring the progress towards restoration goals or objectives at a particular site (e.g., measures of presence/absence and quality of biotic or abiotic components of the ecosystem).
Key ecosystem attributes of ecosystem condition	Key ecosystem attributes assist with the definition of an ecosystem and its condition and the evaluation of progress of ecosystem recovery. They relate to the highest attainable absence of threats, physical and chemical conditions, species composition, structural diversity, ecosystem function, and external exchanges.
Local administrative unit	Local administrative unit is a low-level administrative division of a Member State below that of a province, region or state, established in accordance with Article 4 of Regulation (EC) No 1059/2003 of the European Parliament and of the Council.
Nature-based solutions	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, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions. Nature-based solutions must benefit biodiversity and support the delivery of a range of ecosystem services.
Pollinator	Pollinator is a wild animal which transports pollen from the anther of a plant to the stigma of a plant, enabling fertilisation and the production of seeds.
Pollinator decline	Pollinator decline or decline of pollinator populations means a decrease in abundance or diversity, or both, of pollinators.

<table>
<tr><th>Term</th><th>Meaning or definition</th></tr>
<tr><td>Restoration</td><td> Restoration is the process of actively or passively assisting the recovery of an ecosystem towards or to good condition, of a habitat type to the highest level of condition attainable and to its favourable reference area, of a habitat of a species to a sufficient quality and quantity or of species populations to satisfactory levels, as a means of conserving or enhancing biodiversity and ecosystem resilience.

Restoration is thereby considered the <u>activity</u> (which includes both active and passive restoration measures).
Recovery is thereby considered the <u>outcome</u> sought or achieved through restoration. Full recovery is defined as the condition whereby, following restoration, all key ecosystem attributes closely resemble those of the reference condition (=good condition)

Ecosystem restoration includes measures taken for the improvement of the condition of an ecosystem but also the re-establishment (also referred to as ‘re-creation’) of an ecosystem where it was lost as well as measures to improve connectivity of ecosystems.
Active/passive restoration:

Passive restoration eliminates the factors of degradation and disturbance and permits natural regeneration of the ecosystem.
Active restoration eliminates the source of degradation and disturbance of an ecosystem and implements measures to accelerate its recovery and to overcome obstacles to that recovery.
</td></tr>
<tr><td>Restoration measure</td><td>‘Restoration measure’ means any activity assisting ecosystem recovery actively or passively towards or to good condition and enhancing biodiversity, including measures taken for the improvement of the condition of an ecosystem or for the re-establishment of natural and semi-natural ecosystems, as well as measures to improve the connectivity of natural and semi-natural ecosystems, and to enhance species populations, also across national borders.</td></tr>
<tr><td>Restoration objectives</td><td>Restoration objectives are defined qualitative and quantitative aims regarding the desired condition and area of the ecosystems / habitat types to be restored.</td></tr>
<tr><td>Sufficient quality and quantity of a habitat of a species</td><td>Sufficient quality and quantity of a habitat of a species means the quality and quantity of a habitat of a species which allows the ecological requirements of a species to be fulfilled at any stage of its biological cycle so that it is maintaining itself on a long-term basis as a viable component of its habitat in its natural range.</td></tr>
<tr><td>Sufficient quality of a habitat of a species</td><td>Sufficient quality of a habitat of a species means the quality of a habitat of a species which allows the ecological requirements of a species to be fulfilled at any stage of its biological cycle.</td></tr>
<tr><td>Towns and suburbs</td><td>Towns and suburbs means LAUs where less than 50 % of the population lives in an urban centre, but at least 50 % of the population lives in an urban cluster, in line with the Methodological Manual on Territorial Typologies EUROSTAT 2018.</td></tr>
</table>

Term	Meaning or definition
Urban green space	Urban green space means all green urban areas, broad-leaved forests, coniferous forests, mixed forests, natural grasslands, moors and heathlands, transitional woodland-shrubs and sparsely vegetated areas found within LAUs classified as cities or towns and suburbs, calculated on the basis of data provided by the Copernicus Land Monitoring Service as established by Regulation (EU) 2021/696 of the European Parliament and of the Council.
Urban tree canopy cover	Urban tree canopy cover is the total area of tree cover within cities and towns and suburbs, calculated on the basis of the Tree Cover Density data provided by the Copernicus Land Monitoring Service[3], under the classification of 'vertical projection of tree crowns to a horizontal earth's surface' as established by Regulation (EU) 2021/696 of the European Parliament and of the Council[4], expressed as a percentage of the total LAU area.

[3] https://land.copernicus.eu/pan-european/high-resolution-layers/forests/tree-cover-density.

[4] Regulation (EU) 2021/696 of the European Parliament and of the Council of 28 April 2021 establishing the Union Space Programme and the European Union Agency for the Space Programme and repealing Regulations (EU) No 912/2010, (EU) No 1285/2013 and (EU) No 377/2014 and Decision No 541/2014/EU (OJ L 170, 12.5.2021, p. 69).

1. Introduction: Political and legal context

1.1. Political context

The value of biodiversity and ecosystems has been globally recognised since the Earth Summit in Rio de Janeiro in 1992. Yet, despite efforts at European and international level, biodiversity loss and the degradation of ecosystems continue at an alarming rate in the European Union (EU) and globally. This is widely documented, notably by several IPCC reports[5,6], the Global Resources Outlook[7], the IPBES report[8], the Global Biodiversity Outlook 5[9], and the Dasgupta Review[10]. Ensuring healthy nature, through restoration and protection, is essential for our long-term survival, wellbeing, prosperity and security. Healthy ecosystems provide food, clean water, carbon sinks, protection against growing disaster risks due to climate change, as well as boosting resilience and preventing the emergence and spread of zoonotic diseases.

The 2022 IPCC report[6] highlighted that there is a brief, rapidly closing window to secure a liveable future, as the rise in weather and climate extremes has led to some irreversible impacts as natural and human systems are pushed beyond their ability to adapt. It calls for the implementation of urgent actions for the restoration of degraded ecosystems, to mitigate the impacts of climate change, notably by restoring degraded wetlands and rivers, forest and agricultural ecosystems. The report underlines that climate change and biodiversity loss are the biggest long term threats to food security in the EU.

Furthermore, recent geo-political developments have underlined the need to safeguard food security and the resilience of food systems[11]. Evidence shows that restoring agro-ecosytems has positive impacts on food productivity in the long-term, and more biodiverse and resilient agricultural ecosystems are needed to enhance food security and reduce dependence of imports. The restoration of nature acts as an insurance policy to ensure the EU's long-term sustainability and resilience, against all these challenges.

More decisive action is needed in the EU to protect and restore biodiversity – including through legal instruments – for the Union to achieve its own climate and biodiversity objectives. The

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[5] Intergovernmental Panel on Climate Change (IPCC): Special Report on the impacts of global warming of 1.5°C: https://www.ipcc.ch/sr15/,

[6] IPCC Sixth Assessment Report, Climate Change 2022: Impacts, Adaptation and Vulnerability: https://www.ipcc.ch/report/ar6/wg2/

[7] The International Resource Panel: Global Resources Outlook 2019: Natural Resources for the Future We Want: https://www.resourcepanel.org/reports/global-resources-outlook.

[8] Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services: 2019 Global assessment report on biodiversity and ecosystem services.

[9] Global Biodiversity Outlook 5, Convention on Biological Diversity: reporton on progress towards the Aichi Biodiversity Targets.

[10] Professor Sir Partha Dasgupta, final report of the independent review on The Economics of Biodiversity, 2 February 2021.

[11] COM(2022) 133 final

evaluation[12] of the **EU Biodiversity Strategy to 2020**[13] shows that the EU did not manage to halt the loss of biodiversity in the EU in the 2011-2020 period. The voluntary target to restore by 2020 at least 15 % of degraded ecosystems, in line with the global commitment under the Convention on Biological Diversity, Aichi Target 15[14] was equally not met. The overall picture for biodiversity and ecosystems is bleak and points to the fact that the current approaches are not delivering.

The **European Green Deal**[15] underlined the importance of protecting and restoring nature. The **EU biodiversity strategy for 2030**[16] set targets to protect nature in the EU, but also underlined that protection alone will not be enough. To reverse biodiversity loss, much more is needed to bring back nature to good health across the EU in protected areas and beyond. The strategy thus includes an ambitious EU nature restoration plan. As part of this plan, the Commission committed to put forward a proposal for **legally binding EU nature restoration targets** in 2021 to restore degraded ecosystems, and in particular those with the most potential to remove and store carbon and to prevent and reduce the impact of natural disasters. The primary aim is to reverse biodiversity loss.

Other sectoral strategies of the European Green Deal such as the Zero Pollution Action Plan, the Circular Economy Action Plan, the Forest Strategy, the new Soil Strategy[17], the Farm to Fork Strategy, the EU Adaptation Strategy and the climate-neutrality ambition by 2050, and the so-called Fit for 55% package all will have a positive bearing on biodiversity. However, policy measures without enforceable restortation objectives are unlikely to halt and reverse the current trend of biodiversity degradation in the EU.

The European Parliament and the Council have also highlighted the need to step up efforts to restore ecosystems, for instance in the **Council Conclusions of December 2019**[18] *(*the Council *" stressess the need for urgent additional commitments to halt biodiversity loss, protect and restore terrestrial, freshwater, wetlands and marine ecosystems within and outside protected areas […]")* and in the **European Parliament's resolution of January 2020**[19] (which asked

[12] Trinomics B.V. (2021) Support to the evaluation of the EU Biodiversity Strategy to 2020, and follow-up: Final study report (Publications Office of the EU, 2022). For a summary of main relevant findings: see Annex IX. Commission Report on the evaluation of the EU Biodiversity Strategy to 2020 due in April 2022.

[13] COM/2011/244 final.

[14] The Strategic Plan for 2011-2020 of the Convention on Biological Diversity included 20 'Aichi Biodiversity Targets'. Aichi Target 15 is: 'By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks have been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.'

[15] COM/2019/640 final.

[16] https://ec.europa.eu/environment/strategy/biodiversity-strategy-2030_en#the-business-case-for-biodiversity.

[17] COM(2021) 323

[18] https://www.consilium.europa.eu/en/press/press-releases/2019/12/19/biodiversity-council-adopts-conclusions/.

[19] Resolution on the 15th meeting of the Conference of Parties (COP15) to the Convention on Biological Diversity 2019/2824(RSP).

to “*move away from voluntary commitments and to propose an ambitious and inclusive Strategy that sets legally (and, consequently, enforceable) binding targets for the EU and its Member States*"*)*. In its **resolution of 9 June 2021**[20], the European Parliament *“strongly welcomes the commitment to draw up a legislative proposal on the EU nature restoration plan, including on binding restoration targets”*. The resolution emphasised that the legislative proposal, in addition to an overall restoration target, should also include ecosystem-, habitat- and species-specific targets, that it should include forests, grasslands, wetlands, peatlands, pollinators, free-flowing rivers, coastal areas and marine ecosystems, that restoration should contribute to biodiversity as well as to climate change mitigation and adaptation, and stressed the importance of ensuring non-deterioration of restored ecosystems.

Public support for nature restoration is very high and the engagement to protect and restore nature among citizens, and especially among youth, is on the rise. In the **Eurobarometer survey on biodiversity (2018-2019)**[21], respondents ranked restoration of nature among the most important actions that the EU should take to protect biodiversity. This public interest is also apparent in the replies (in number and in content) to recent public consultations on nature-related initiatives[22]. Healthy nature delivers a range of services to the society and businesses. Worldwide, the loss of ecosystem services is estimated at about ten trillion euros per year[3], more than five times the entire value of agriculture in the market economy. Yet nature’s value goes beyond economic goods and services: most EU citizens highly value its very existence and recognise its intrinsic worth, consistently identifying ecological degradation as an urgent concern.

The restoration of ecosystems is high on the **international agenda**. The **2050 vision under the Convention on Biological Diversity**[23], the **United Nations Convention to Combat Desertification (UNCCD)**[24], the **2030 Agenda for Sustainable Development**[25] and the **UN Decade for Restoration**[26], all call for the protection and restoration of ecosystems.

The Convention on Biological Diversity – agreed at the Rio Summit – will hold an important Conference of the Parties (COP15 starting in October 2021) which is expected to conclude a new Global Biodiversity Framework including ambitious restoration targets to be agreed by the end of 2022. The EU is taking leadership on the global stage to mobilise the international community, all the stakeholders and society at large, to take action to halt the loss of

[20] European Parliament resolution of 9 June 2021 on the EU Biodiversity Strategy for 2030: Bringing nature back into our lives (2020/2273(INI).

[21] Eurobarometer: Stronger EU action to protect nature.

[22] E.g. Fitness Check of the Birds and Habitats Directives: more than 552 000 replies, the combined consultation on the evaluation of the EU Biodiversity Strategy to 2020, the review of the application of the EU Regulation on Invasive Alien Species and the development of legally binding EU nature restoration targets: over 111 000 replies.

[23] First Draft of the Post-2020 Global Biodiversity Framework.

[24] https://www.unccd.int/.

[25] United Nations: Resolution adopted by the General Assembly on 25 September 2015.

[26] https://www.decadeonrestoration.org/about-un-decade.

biodiversity. The EU's Biodiversity Strategy for 2030 is a blueprint to make this a reality in the EU and to project the EU's commitment also at global level. The nature restoration proposal announced in the Strategy will send a strong signal to the global community that the EU is taking its commitment seriously and aims to enshrine ecosystem restoration targets into law.

Restoration will also help meet the EU's commitments under the United Nations Framework Convention on Climate Change (UNFCCC), and its **Paris Agreement**[27], as ecosystems such as peatlands, wetlands, oceans and forests can, when they are in good condition, remove and store large amounts of carbon dioxide and are also instrumental in contributing to climate change adaptation. Nature and the restoration of ecosystems was one of the **five main priorities**[28] for the 26th United Nations Climate Change Conference of the Parties (COP 26).

Restoring nature across the EU is among the core pillars of the European Green Deal. It is intrinsically linked to achieving the Union's biodiversity and climate change objectives. The restoration objectives are specifically spelled out in the Biodiversity Strategy's headline ambition to ensure that that Europe's biodiversity is on the path to recovery by 2030 and that by 2050 all ecosystems are restored, resilient, and adequately protected. The EU Adaptation Strategy[29] also calls specifically for scaling up nature-based solutions such as ecosystem restoration as they will help adapt to climate change in a cost-effective way. Restoring nature would thus significantly contribute to the EU's climate mitigation and adaptation objectives, and to the EU's international commitments.

1.2. Legal context

1.2.1. Existing EU legislation relevant to ecosystem restoration

EU environmental law includes legislation that has a positive bearing on the restoration of EU ecosystems. For instance, the **Birds Directive**[30] (BD) requires Member States to not only maintain bird habitats but also re-establish destroyed biotopes for birds. The **Habitats Directive**[31] (HD) aims to maintain or restore, at favourable conservation status, natural habitats and non-bird species of wild fauna and flora of Community interest. The **Water Framework Directive**[32] (WFD) aims at achieving good status[33] of all EU freshwaters, ground waters, transitional waters and coastal waters by 2015 (with extensions up to 2027). The **Marine**

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[27] https://unfccc.int/sites/default/files/english_paris_agreement.pdf.

[28] https://ukcop26.org/.

[29] COM(2021) 82 final

[30] Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds.

[31] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

[32] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy..

[33] Good ecological status or potential and chemical status for surface water, good quantitative and chemical status for groundwater.

Strategy Framework Directive[34] (MSFD) currently under review, aimed at achieving and maintaining good environmental status of all the EU's marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. The **Environmental Liability Directive**[35] (ELD) establishes a framework based on the polluter pays principle to prevent and remedy environmental damage. The **Invasive Alien Species Regulation**[36] provides for a set of measures to be taken acrosse the EU in relation to invasive alien species included in the Union list. All these pieces of legislation contribute to the improvement and restoration of ecosystems but together the outcomes are largely insufficient to address the extent and scale of the problem. Further details of the reasons for some of the policy and legislative failures are given in chapter 2.

As part of the European Green Deal, a variety of initiatives are underway which will be relevant to the restoration of ecosystems. These include the new legal framework for the **Common Agricultural Policy**[37], the **European Climate Law**[38], as well as the set of proposals put forward in July 2021 that form the Fit for 55 package, which comprises notably the proposals to revise the Regulation on land use, land use change and forestry (**LULUCF**[39]), the Energy Efficiency Directive, the Renewable Energy Directive[40] as well as the EU Forest Strategy. Ecosystem restoration will also be facilitated by the new carbon farming initiative[41] and by the law on soil health which is announced in the EU Soil Strategy for 2030. An overview of existing and forthcoming initiatives and explanation of their relevance is included in Annex X.

[34] Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy.

[35] Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage.

[36] Regulation (EU) 1143/2014 on invasive alien species.

[37] The new common agricultural policy: 2023-27.

[38] COM/2020/80 final.

[39] https://ec.europa.eu/clima/policies/forests/lulucf_en, COM(2021)554

[40] https://ec.europa.eu/info/news/commission-presents-renewable-energy-directive-revision-2021-jul-14_en

[41] Communication on sustainable carbon cycles: COM(2021) 800; Have your say: Climate change: restoring sustainable carbon cycles.

2. PROBLEM DEFINITION

2.1. What are the problems?

2.1.1 General problem: biodiversity loss and degradation of ecosystems in the EU

Recent assessments[42] of the state of biodiversity in the EU show that biodiversity loss and the degradation of ecosystems, continue at an alarming rate, across the broad range of ecosystem types in the EU. These include forests, wetlands, rivers and lakes, heath and scrub, sparsely vegetated land, agro-ecosytems (grassland and cropland), urban and marine ecosystems. Their restoration is central to ensuring human health, wellbeing and for tackling and adapting to climate change. It is necessary to halt biodiversity loss to ensure that future generations can continue to benefit from the services that nature provides to the society including to a broad range of economic sectors.

The **EU-wide ecosystem assessment**, also called MAES-report, published by the European Commission in 2021, brings together for the first time EU-wide and commonly agreed data sets that can be used to assess the state and trends of ecosystems and their services as well as the pressures and their trends they are exposed to. It contributes substantially to our understanding of ecosystems, their degradation and threat so as to guide priority and cost-effective restoration efforts.

The assessments indicate that substantial efforts are needed to put ecosystems on a path to recovery, so that they can deliver benefits to society. The EU Ecosystem Assessment[43] demonstrated that most habitats listed in Annex I of the Habitats Directive and water bodies in the Water Framework Directive are not in favourable conservation status (Figure 1). Ecosystem degradation threatens the supply of vital ecosystem services such as food security and carbon sequestration (see 2.1.3).

[42] The European environment — state and outlook 2020 (EEA), The State of Nature in the EU report (COM/2020/635 final) and the EU Ecosystem Assessment, 2021.

[43] The EU Ecosystem Assessment is an analysis of the trends in pressures on ecosystems, ecosystem condition, and ecosystem services of ecosystems in the EU using 2010 as baseline. The scientific report is available here; a summary for policy makers is available here. For simplicity, the SWD cites both documents as 'EU Ecosystem Assessment'.

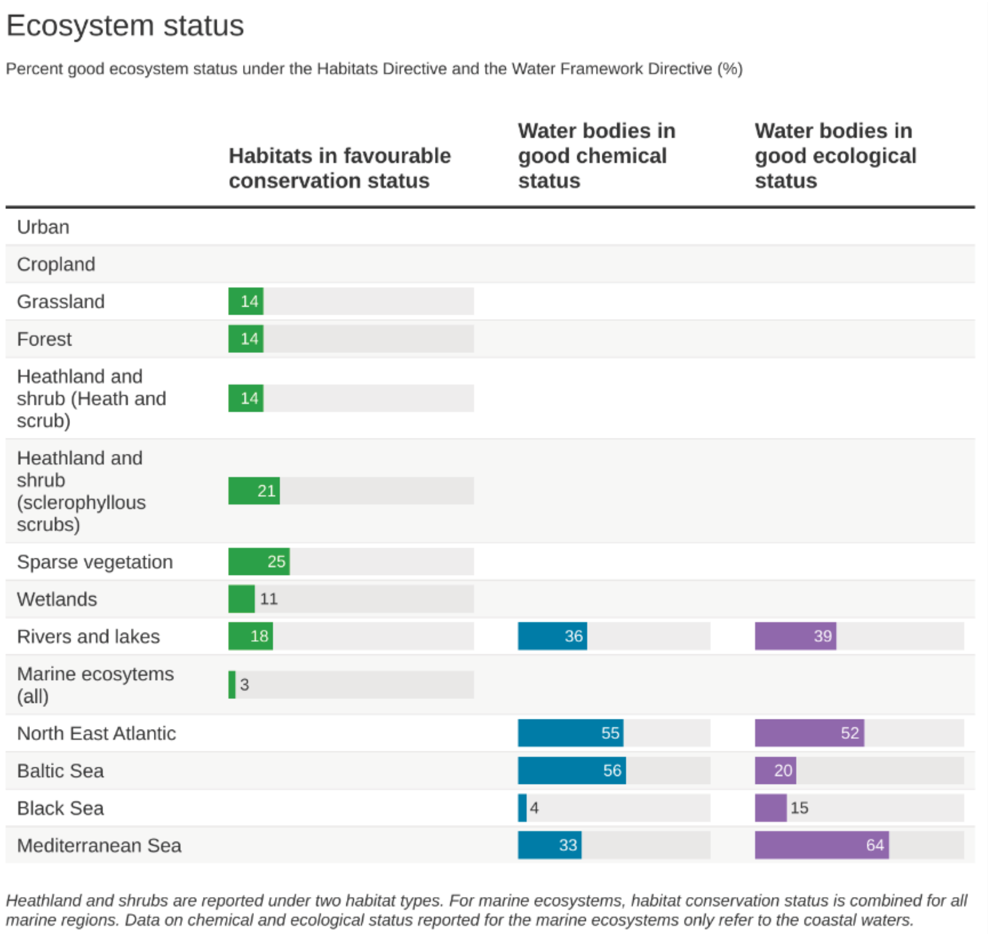

Figure 1: The share of habitats in favourable conservation status and the share of water bodies in good chemical and ecological status (counted in percentage of number of habitat assessments). (EU Ecosystem Assessment, 2021)

All terrestrial Annex I habitats represent 24 % of the EU land territory and the marine Annex I habitats cover 240 030 km^2 (4.8 %) of the EU seas[44].

[44] Romania is not included due to data issues.

Figure 2 below shows the proportion (area) of the EU ecosystem types which is covered by the Habitats and the Birds[45], Water Framework and Marine Strategy Framework Directives, and the area which is part of the Natura 2000 network. It also shows that large areas of EU ecosystems, primarily heavily modified ones such as urban, cropland and forests are not covered by those pieces of legislation due to their main use for production, habitation or infrastructure and thus do not benefit from the same level of protection, restoration and monitoring requirements.

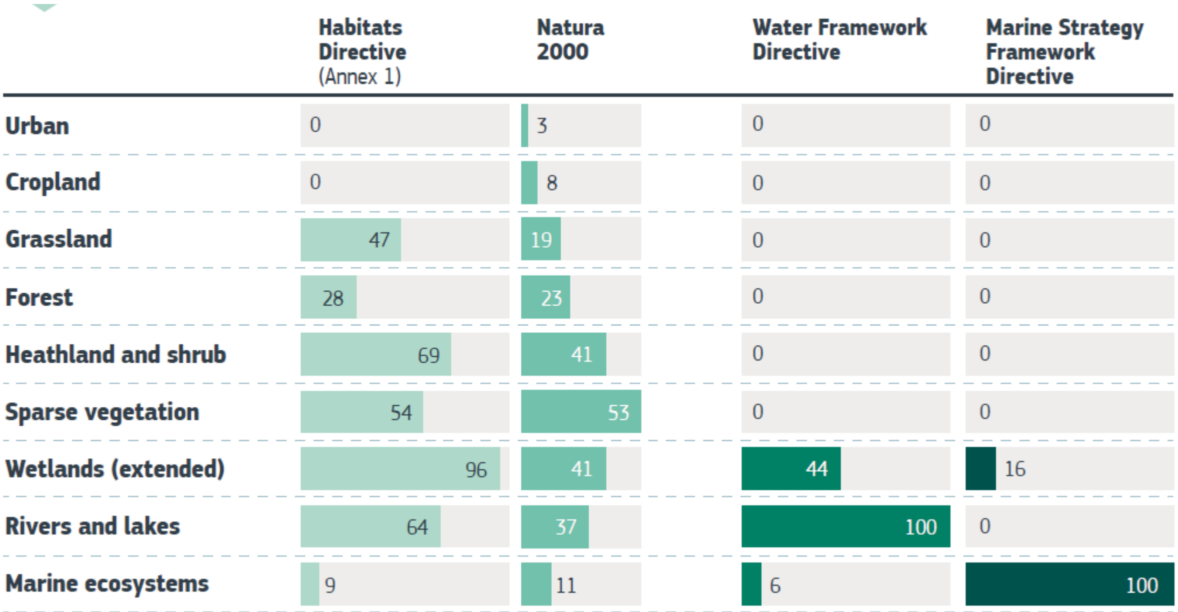

Figure 2: : The relative share (%) of ecosystems area covered by the Habitats and Birds Directives, the Water Framework Directive and the Marine Strategy Framework Directive. Natura 2000 is the nature protection network established under the Habitats Directive.

As a result, the condition of these ecosystems is less known. However,the continuous decline of common farmland bird species on agricultural land[46], the rise in clear-cut forest harvesting[47], evidence of soil degradation and erosion affecting 25% of agricultural land[48] and the dramatic decline of insects and pollinators[49] all point to a need for improvement. Evidence from the

[45] In relation to the Habitats Directive, only the area covered by habitats listed in Annex I is presented as well as the area covered by Sites of Community Importance/Special Areas of Conservation. In relation to the Birds Directive, only the area covered by Special Protection Zones is presented. Sites of Community Importance/Special Areas of Conservation and Special Protection Zones are referred to as Natura 2000.

[46] EUROSTAT: Common farmland bird populations continue to decline: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/edn-20210522-1

[47] Recent surge in EU forest harvesting, according to JRC study: https://ec.europa.eu/jrc/en/news/recent-surge-eu-forest-harvesting-according-jrc-study

[48] Jonathan Smith, Horizon: The EU Research & Innovation Magazine, 15 Sept 2021: Research initiative to build framework for climate-smart sustainable agricultural soil management

[49] Hallmann CA, Sorg M, Jongejans E,Siepel H, Hofland N, Schwan H, et al. (2017) More than 75 percent decline over 27 years in total flying insect biomass in protected areas. PLoS ONE 12(10):

Horizon 'Soil Health and Food' Mission suggests that 60-70 % of EU soils are in unhealthy condition and costs associated with soil degradation in the EU exceed 50 billion € per year[50].

The **State of Nature in the EU report**[51] has shown that in 2018, 81 % of assessments[52] of **EU-protected habitats**[53] listed in Annex I of the Habitats Directive show an unfavourable ('poor' or 'bad') status (compared to 77 % in 2013), of which 36 % are deteriorating and only 9 % improving.

Figure 3 shows that large differences exist between Member States in conservation status of those habitats.

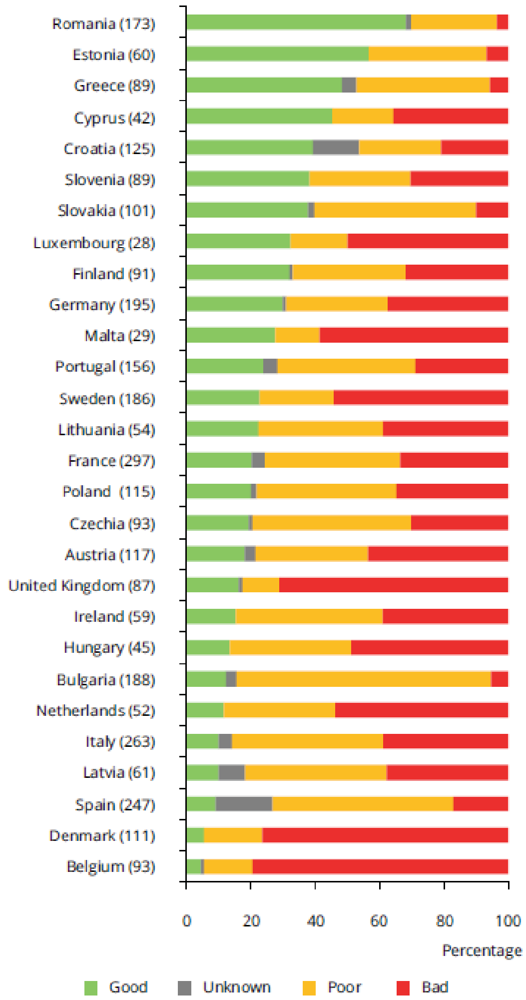

Figure 3: Conservation status of habitats listed in Annex I of the Habitats Directive at Member State level (State of Nature report, EEA).

Many of the Annex I habitats requiring restoration (such as peatland, forests, grassland, cropland) are particularly carbon-rich, thus offering significant potential to store and sequestrate carbon in the above- and below-ground biomass and in the soil. Their restoration and maintenance could contribute significantly to climate change mitigation. For example, restoring drained peatlands in the EU by rewetting them could reduce CO_2 emissions by about 50 $MtCO_2$ eq per year[54], as well as provide a healthy habitat for valuable species. Restoration of healthy ecosystems is also crucial for climate adaptation and to mitigate the impacts of natural disasters. For instance, improving the condition of soils leads to better water absorption and retention, soil retention and temperature cooling. Restoration and climate adaptation are not only important because of the ecosystem services to people, but also for nature itself. Restored ecosystem that are

[50] Mission Board Soil health and food, *'Caring for Soil is Caring for Life'*, European Commission, Directorate-General for Research and Innovation, 2020.

[51] The report is based on an analysis by the European Environment Agency of EU Member State reporting under the Birds and Habitats Directives.

[52] The State of Nature report shows the number of reports for each conservation status and does not reflect the shares of habitat area or species population in each Member State.

[53] https://www.cbd.int/convention/articles/?a=cbd-02.

[54] McDonald, H., Frelih-Larsen, A., Lóránt, A., Duin, L., Pyndt Andersen, S., Costa, G., and Bradley, H. 2021, Carbon farming – Making agriculture fit for 2030, Study for the committee on Environment, Public Health and Food Safety (ENVI), Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, Luxembourg.

more biodiverse, larger and better connected will be less vulnerability to climate change. In other words, we need more space for nature and natural processes in order to make nature more resilient and to minimise predicted ecosystem degradation and biodiversity loss due to climate change. The biodiversity and climate crisis are closely connected and so are their solutions.

Annex VIII provides information on the distribution, condition, pressures and trends for the EU ecosystems which Member States report on under the Habitats Directive. Annex VI provides further data and analysis on these ecosystems and beyond, covering for instance also soils, pollinators and urban ecosystems. A comprehensive overview is also available in the EU Ecosystem Assessment.

In summary, the problem is clear: biodiversity loss and the degradation of ecosystems continue at an alarming rate in the EU (albeit not at equal rate). This degradation is evident across the main EU ecosystem types: wetlands, forests, agro-ecosystems (including grassland and cropland), marine ecosystems, heathland, scrub, sparse vegetation, lakes, rivers and alluvial ecosystems, urban ecosystems and soils. Their restoration is central to ensure human health, wellbeing and for tackling and adapting to climate change.

Figure 4 shows the relative area covered by the main ecosystem types in the EU and the sum of their area[55]. Their geographical distribution is presented in Figure 5 (more detailed maps are in Annex VIII). It should be noted that soils are considered as a cross-cutting ecosystem in its own right, that underpin most terrestrial ecosystems. Note that the figures and tables in this chapter result from reports and data compiled before 2021 (based on data until 2018), and thus they cover the EU and the UK (EU-28).

Information on ecosystem-specific data availability is provided in the ecosystem-specific assessments in Annex VI.

[55] In Figure 4, 'urban' relates to 'Artificial surfaces' (Corine land cover type 1), which represents a smaller area than the 'Local Administrative Units'used for the impact assessment.

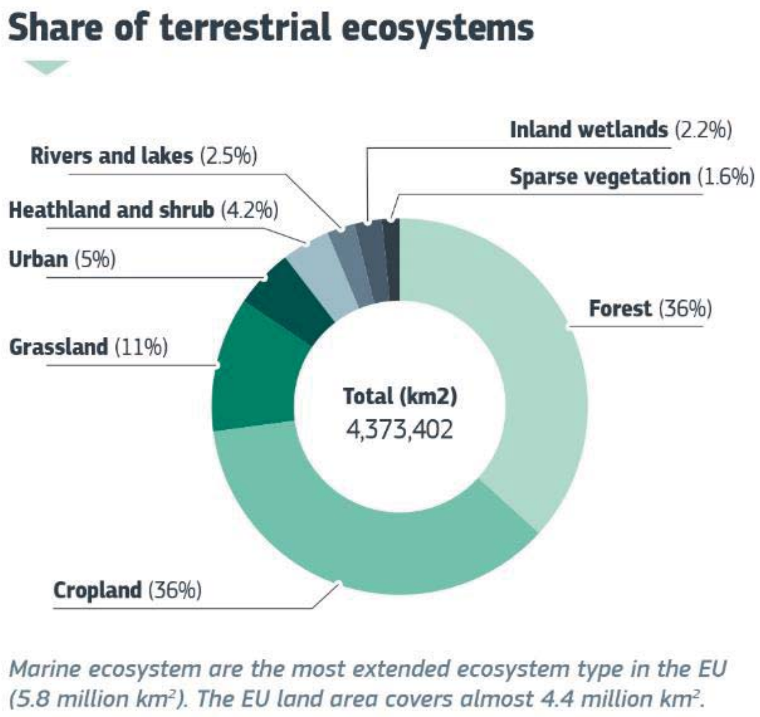

Figure 4: The share of terrestrial ecosystems[55] in the EU and the UK in 2018. Source: EU Ecosystem Assessment (Corine Land cover, European Environment Agency, 2018)

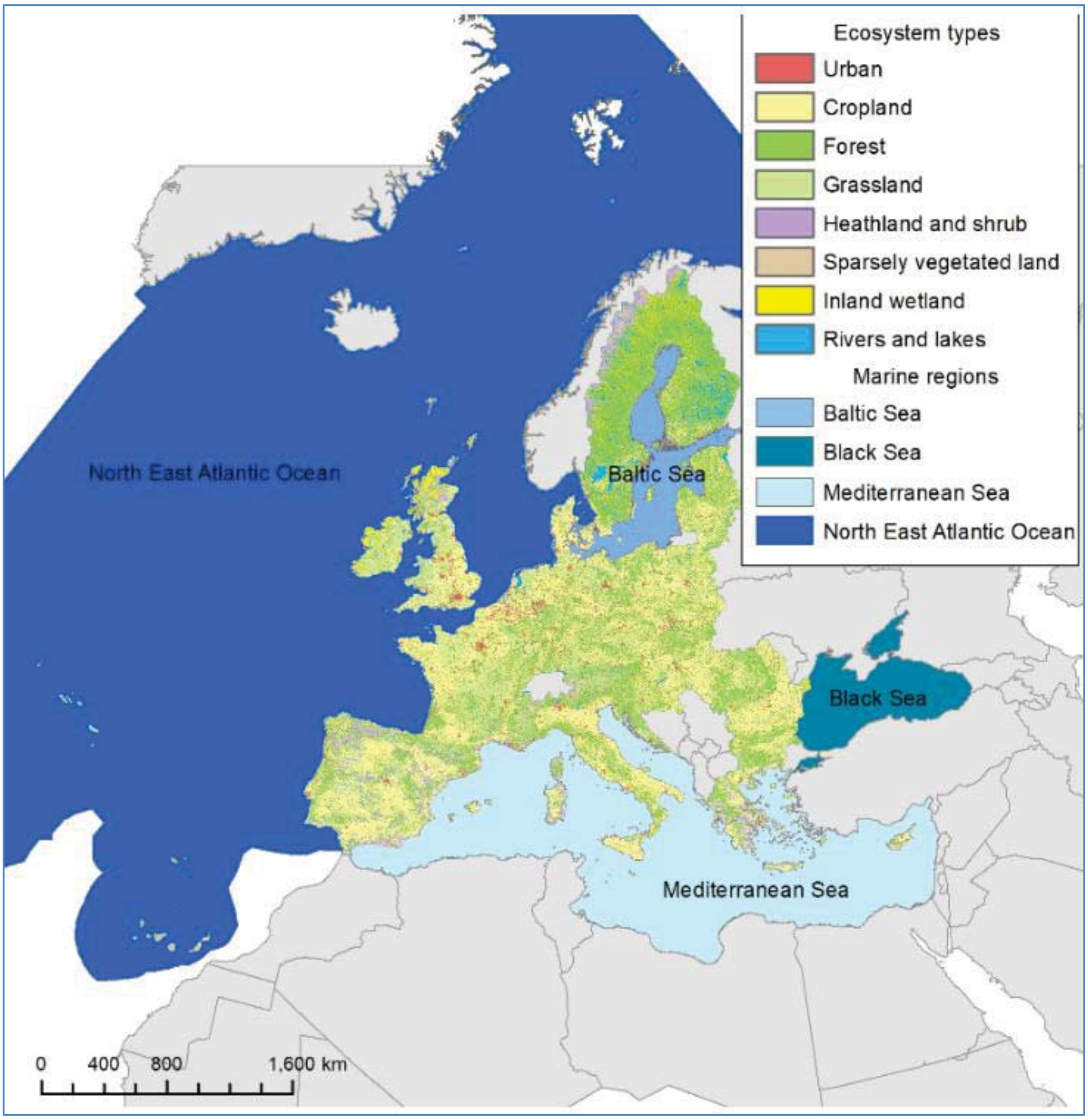

Figure 5: Main ecosystems types in the EU and the UK in 2018 (EU Ecosystem Assessment)

2.1.2. Specific problem: ecosystem restoration efforts have been insufficient so far

As stated in the EU Biodiversity Strategy for 2030: "*Protecting the nature we have will not be enough to bring nature back into our lives. To reverse biodiversity loss, we need to be more ambitious **on nature restoration**.*" Protecting an ecosystem does not guarantee that it will evolve spontaneously to good condition – and degraded ecosystems that are not protected also need to be restored. The state of ecosystems covered under EU environmental legislation has not improved over the past decade and their condition is to a large part deteriorating.

The EU Ecosystem Assessment highlights the need to avoid further degradation and to restore degraded ecosystems. In some cases, passive restoration, by removing pressures, can be sufficient, so that ecosystems can recover by themselves. In other cases, degraded ecosystems need active restoration intervention to recover and become more resilient. In some cases, ecosystem re-creation is needed when land has been transformed into entirely other types of use, so that the ecosystem cannot simply evolve back (see glossary on different types of restoration).

Enhanced ecosystem restoration, both passive and active, would significantly contribute to addressing all of the key drivers of biodiversity loss and ecosystem degradation. For instance, passive restoration can involve the easing of pressures (e.g. overexploitation in marine areas or forests, or air or water pollution). These can help ecosystems recover by themselves to an extent. Active restoration entails actions to help ecosystems that have been damaged beyond their capacity to recover alone, for example re-establishing former land use or remodelling land or seascapes. Other active restoration actions require removing alien species or removing pollutants directly from the ecosystem (e.g. soil remediation, cleaning up litter). Beyond removing local pressures, restoration will also help reducing key drivers of biodiversity loss on a wider scale, for example, wetland restoration contributes to capturing carbon and mitigating climate change effects such as flooding.

Findings of **the evaluation of the EU Biodiversity Strategy to 2020**[56] indicate that the voluntary target to maintain and restore ecosystems has not been achieved. Further results from the evaluation are available in Annex IX. The EEA's **State of Nature in the EU** report[57] also points towards the gap in restoration, while deterioration continues and climate impacts and risks increase. Furthermore, the underlying drivers of soil degradation are not projected to change favourably by 2030.

Based on Member States' reporting, the EEA has made estimates of restoration needs to bring habitats listed in Annex I of the Habitats Directive (representing 24% of the EU land area and 4.8% sea area) to favourable conservation status (see detailed data in Annex VIII). The estimates show that significant areas of the EU need to be restored (Table I per habitat type and further broken down in Table II, III and IV). As explained in 2.1.1, the condition of terrestrial ecosystems outside of Annex I habitats, (the remaining 76% of land), because they are not subject to the same protection regime or conservation measures, is likely to be worse and thus their restoration needs are likely to be higher.

The specific problem is that ecosystem restoration across the EU has been insufficient so far, while ecosystems continue to degrade.

[56] See footnotes 12 and 13 .

[57] https://www.eea.europa.eu/publications/state-of-nature-in-the-eu-2020.

Table I: Restoration needs of habitats listed in Annex I of the Habitats Directive based on reporting by Member States (2013-2018). Romania is excluded because its reported Annex I areas exceed the terrestrial area of the country. Source: EEA.

Ecosystem based on Annex I types *(N° of Annex I habitat types)*	**Surface[1] Annex I habitats in km²**	**Condition in km² & %**			**Overall restoration needs in km²**	
		Good	Not good	Unknown	Area re-establishment (min/max)	Improvement in condition (min/max)
Wetlands[2] (inland & coastal) *(28)*	174 400	62 950 36%	27 100 16%	84 300 48%	3 131 6 910	27 100 111 400
Forests[3] *(69)*	357 952	162 300 45%	79 210 22%	116 444 33%	3 487 8332	79 210 195 000
Agro-habitats and grasslands[4] *(35)*	177 442	84 150 47%	31 180 18%	62 100 35%	2 431 8 798	31 180 93 000
River, lakes, alluvial and riparian habitats[5] *(32)*	96 480	52 970 55%	21 560 22%	21 950 23%	894 2 743	21 560 38 000
Heath & scrub[6] *(21)*	78 582	43 420 55%	6 590 8%	28 600 36%	405 928	6 586 35 000
Rocky and (Coastal) & dunes *(41)*	65 135	30 048 46%	6 619 10%	28 500 44%	355 1 458	6 619 35 100
Total Terrestrial	**949 990**	**435 838 46%**	**172 259 18%**	**341 894 36%**	**10 703 29 169[8]**	**172 255 505 500[9]**
				Total restoration terrestrial:	**182 985 – 536 669 km² [10]**	
Marine[7] *(4)*	**240 030**	36 810 15%	34 830 15%	168 390 70%	1 622 3 424	34 828 203 200
				Total restoration marine:	**36 450 – 206 624 km² [11]**	

[1] Areas of Annex I terrestrial habitats reported by Romania exceed the terrestrial area of the Member State; therefore, they were excluded from all numbers in the table.
[2] All wetland Annex I habitats (definition of wetlands by the Ramsar Convention) except rivers, lakes, alluvial and riparian habitats, which form a distinct group.
[3] All Annex I habitats in the group 'Forests', except wet, alluvial and riparian forests and wooded meadows, which were included in other groups (wetlands, rivers & lakes, agro-habitats).
[4] Includes Annex I habitat types, mostly semi-natural, that depend on some degree of agricultural activity (e.g. mowing, grazing) and grasslands.
[5] Includes all Annex I river and lake habitats and several riparian and alluvial habitats (meadows and forests).
[6] Includes all Annex I heath, scrub and steppe habitats, except wet heaths (included in the wetlands group) and some heath and scrub that depend on agricultural activities.
[7] Only includes near- and offshore Annex I marine habitats.
[8] This means 0,3-0,75% of EU land
[9] This means 4,4-13% of EU land
[10] This means a total restoration need of 4,7-13,8% of EU land
[11] This means 0,65 – 3,7% of EU seas

Table II: Overall restoration needs, by Member State, of habitats listed in Annex I of the Habitats Directive, based on reporting by Member States (period 2013-2018) under Art.17 of the HD – EU27 (excluding Romania for data quality reasons). Source: EEA.

Member State	Member State surface in km²	Overall restoration needs (all ecosystems) in km² **TERRESTRIAL**				Overall restoration needs in km² **MARINE**
		Area re-establishment (min/max)	Area improvement (min/max)	**Total restoration area (min/max)**	**% of MS territory (min/max)**	**(min/max)**
Austria	83 944	229 / 846	1 215 / 4 778	1 444 / 5 624	1.7 / 6.7	n.a.
Belgium	30 683	106 / 515	571 / 2 410	677 / 2 925	2.2 / 9.5	477 / 1867
Bulgaria	110 995	0 / 0	223 / 5 030	223 / 5 030	0.2 / 4.5	0 / 117
Cyprus	9 249	0 / 0	265 / 269	265 / 269	2.9 / 2.9	0 / 0
Czechia	78 874	0 / 1	881 / 2435	881 / 2 435	1.1 / 3.1	n.a.
Germany	362 177	531 / 1 752	4 813 / 7 058	5 344 / 8 811	1.5 / 2.4	3 354 / 11 944
Denmark	44 162	22 / 102	3 179 / 8 224	3 508 / 8 942	7.9 / 20.2	12 391 / 17 702
Estonia	45 382	0 / 0	907 / 1 962	907 / 1 962	2.0 / 4.3	91 / 852
Spain	506 222	1 466 / 3 026	25 017 / 110 384	26 483 / 113 410	5.2 / 22.4	82 / 12 814
Finland	338 004	3 166 / 6 334	19 348 / 80 619	22 514 / 86 953	6.7 / 25.7	573 / 3 024
France[58]	551 881	866 / 2 650	72 826 / 91 385	73 693 / 94 035	13.4 / 17.0	2 720 / 26 832
Greece	132 014	48 / 96	602 / 7 156	650 / 7 253	0.5 / 5.5	3 564 / 7 176
Croatia	55 590	32 / 66	319 / 6 842	351 / 6 908	0.6 / 12.4	0 / 798

[58] *The French reports have a lot of duplicated data between 'good', 'not-good' and 'unknown' condition; in addition, they reported often a max value obtained from modelling/potential vegetation, which may have also increased the areas.*

Hungary	93 012	127 / 335	3 417 / 4 693	3 544 / 5 029	3.8 / 5.4	n.a.
Ireland	70 699	313 / 640	5 180 / 5 657	5 493 / 6 297	7.8 / 8.9	3 014 / 24 542
Italy	301 321	3 035 / 10 175	2 216 / 57 158	5 251 / 67 333	1.7 / 22.3	0 / 3 981
Lithuania	65 289	70 / 140	308 / 4 436	378 / 4 576	0.6 / 7.0	0 / 285
Luxembourg	2 595	9 / 18	125 / 146	134 / 164	5.2 / 6.3	n.a.
Latvia	64 590	1 / 3	1 091 / 3 138	1 092 / 3 141	1.7 / 4.9	985 / 1 038
Malta	316	0 / 0	17 / 17	17 / 17	5.5 / 5.5	4 / 69
Netherlands	39 898	97 / 353	1 026 / 2 952	1 123 / 3 305	2.8 / 8.3	8 916 / 10 236
Poland	312 683	22 / 44	14 044 / 14 439	14 066 / 14 483	4.5 / 4.6	220 / 220
Portugal	92 378	126 / 253	1 612 / 6 117	1 737 / 6 369	1.9 / 6.9	0 / 65 290
Romania	*238 404*	*979 / 1 959*	*11 704 / 55 023*	*12 683 / 56 982*	*5.3 / 23.9*	*1 889 / 1945*
Sweden	450 110	298 / 1 474	10 925 / 74 646	11 223 / 76 120	2.5 / 16.9	61 / 17 891
Slovenia	20 274	87 / 244	2 015 / 2 599	2 103 / 2 843	10.4 / 14.0	<1 / <1
Slovakia	49 026	51 / 102	137 / 9 548	188 / 9 649	0.4 / 19.7	n.a.

Table III: MINIMUM restoration needs, by Member State and by Annex I habitat, based on reporting by Member States (period 2013-2018) under Art.17 of the HD – EU27. Source: EEA.

		MINIMUM ecosystem areas (km^2) for restoration (improvement + re-establishment)						
	MS area (km^2)	Wetlands	Rivers & lakes	Grasslands & agri	Forests	Heath & scrub	Rocky & dunes	Terrestrial
AT	83.944	36	164	127	603	12	502	**1.444**
BE	30.683	26	259	118	238	0	36	**677**
BG	110.995	0	222	0	1	0	0	**223**
CY	9.249	3	17	4	216	26	0	**265**
CZ	78.874	17	170	227	461	0	5	**881**
DE	362.177	1.814	1.374	899	1.179	16	62	**5.344**
DK	44.162	1.387	550	352	642	0	271	**3.201**
EE	45.382	464	53	93	290	0	7	**907**
ES	506.222	482	639	6.602	14.602	3.762	396	**26.483**
FI	338.004	10.794	3.661	24	5.676	1.980	379	**22.514**
FR	551.881	1.030	6.873	14.701	46.949	77	4.069	**73.699**
GR	132.014	303	37	52	204	39	15	**650**
HR	55.590	1	205	116	29	0	0	**351**
HU	93.012	603	663	670	1.525	2	81	**3.544**
IE	70.699	3.753	928	692	19	54	47	**5.493**
IT	301.321	279	504	1.653	2.313	255	247	**5.251**
LT	65.289	84	84	143	56	0	11	**378**
LU	2.595	0	3	129	1	0	0	**134**
LV	64.590	367	200	122	355	0	48	**1.092**
MT	316	0	0	5	0	7	5	**17**
NL	39.898	614	103	139	88	0	179	**1.123**
PL	312.683	1.706	3.831	4.224	4.133	15	157	**14.066**

		MINIMUM ecosystem areas (km^2) for restoration (improvement + re-establishment)						
	MS area (km^2)	**Wetlands**	**Rivers & lakes**	**Grasslands & agri**	**Forests**	**Heath & scrub**	**Rocky & dunes**	**Terrestrial**
PT	92.378	350	37	230	261	739	120	**1.737**
RO	238.404	2.355	3.273	2.815	3.702	12	526	**12.683**
SE	450.110	6.132	1.655	1.867	1.250[59]	0	320	**11.223**
SI	20.274	4	202	366	1.509	7	15	**2.103**
SK	49.026	5	25	57	96	3	1	**188**
Total EU27	**4.149.772**	32.609	25.730	36.429	86.400	7.003	7.501	**195.671**
Total without RO[60]	**3.911.368**	**30.254**	**22.457**	**33.614**	**82.698**	**6.991**	**6.974**	**182.988**

[59] Sweden forests: reported Favorable Reference Area values leading to a re-establishment of over 24 500 km^2; not included in the table due to methodological issues.
[60] For data quality reasons.

Table IV: MINIMUM restoration needs, by improvement/re-establishment, by Member State and by Annex I habitats, based on reporting by Member States (period 2013-2018) under Art.17 of the HD – EU27. Source: EEA.

Condition: area reported in 'not-good' condition: in need of improvement. Zeros often reflect that most areas have been reported as 'unknown condition'

Additional: for re-establishment: based on minimum Favorable Reference Areas.

	MINIMUM ecosystem areas (km²) for restoration (improvement and re-establishment)												
	Wetlands		**Rivers & lakes**		**Grasslands**		**Forests**		**Heath & scrub**		**Rocky & dunes**		
	condition	**Additional**	**condition**	**Additional**	**condition**	**additional**	**condition**	**additional**	**condition**	**additional**	**condition**	**additional**	**Terre-strial**
AT	27	9	107	57	22	104	590	13	12	0	456	46	**1.444**
BE	17	9	231	28	99	19	192	45	0	0	31	5	**677**
BG	0	0	222	0	0	0	1	0	0	0	0	0	**223**
CY	3	0	17	0	4	0	216	0	26	0	0	0	**265**
CZ	17	0	170	0	227	0	461	0	0	0	5	0	**881**
DE	1.773	41	1.177	197	665	234	1.129	50	16	0	54	7	**5.344**
DK	1.382	4	550	0	334	17	642	0		0	271	0	**3.201**
EE	464	0	53	0	93	0	290	0		0	7	0	**907**
ES	482	1	553	85	6.536	65	13.608	994	3.476	286	360	35	**26.483**
FI	8.413	2.381	3.660	1	18	7	4.901	775	1.980	0	377	1	**22.514**
FR	788	243	6.678	195	14.428	273	46.922	28	77	0	3.941	127	**73.699**
GR	261	42	36	1	52	0	204	0	39	0	11	5	**650**
HR	0	0	202	2	102	14	14	15	0	0	0	0	**351**
HU	603	0	608	55	607	63	1.520	5	2	1	79	3	**3.544**
IE	3.527	226	928	0	611	82	19	0	54	0	42	4	**5.493**
IT	191	88	291	213	590	1.064	845	1.468	136	119	163	84	**5.251**
LT	77	7	83	1	140	3	0	56		0	9	3	**378**

	MINIMUM ecosystem areas (km²) for restoration (improvement and re-establishment)												
	Wetlands		**Rivers & lakes**		**Grasslands**		**Forests**		**Heath & scrub**		**Rocky & dunes**		
	condition	**Additional**	**condition**	**Additional**	**condition**	**additional**	**condition**	**additional**	**condition**	**additional**	**condition**	**additional**	**Terre-strial**
LU	0	0	2	1	122	7	1	0	0	0	0	0	**134**
LV	367	0	200	0	122	0	355	0		0	47	1	**1.092**
MT	0	0	0	0	5	0	0	0	7	0	5	0	**17**
NL	560	54	96	7	126	14	81	8		0	164	15	**1.123**
PL	1.702	3	3.820	12	4.218	7	4.133	0	15	0	157	0	**14.066**
PT	338	12	37	0	130	100	261	0	739	0	107	14	**1.737**
RO	2.251	104	3.027	247	2.500	315	3.401	301	0	12	526	0	**12.683**
SE	6.125	7	1.650	5	1.585	282	1.250	0[61]	0	0	315	4	**11.223**
SI	3	0	177	25	306	60	1.508	2	7	0	15	0	**2.103**
SK	3	2	17	8	43	14	69	27	3	0	1	0	**188**
Total EU27	29.374	3.235	24.589	1.140	33.683	2.746	82.612	3.788	6.586	417	7.145	355	**195.671**
without RO	27.124	3.131	21.563	894	31.183	2.431	79.211	3.487	6.586	405	6.619	355	**182.988**

[61] Sweden forests: reported FRA values leading to a re-establishment of over 24 500 km^2; not included in the table due to methodological issues.

2.1.3. Consequences/why is it an issue

Biodiversity loss and ecosystem collapse are one of **the biggest threats facing humanity in the next decade because our lives are directly dependent on healthy ecosystems.**[62] They also threaten the foundations of our economy and **the costs of inaction are high and are anticipated to increase**[63]. Insufficient restoration and the further undermining of ecosystem resilience pose significant risks to the security of supply of critical supporting **ecosystem services**, such as nutrient and water cycles, soil formation, carbon sequestration and pollination. These in turn put at risk the delivery of key provisioning ecosystem services, such as **food**[64], freshwater, bio-materials, cultural services (recreation, education, tourism, aesthetics) and rural livelihoods as well as regulating services, such as disease regulation, air and water quality and security, as well as climate change and disaster risk mitigation and adaptation.

Furthermore, forests, grasslands, wetlands, peatlands, marine and soil ecosystems can take up and store large amounts of carbon from the atmosphere. Degradation or loss of these ecosystems not only reduces the capacity of the valuable natural carbon sinks but can also have the effect of releasing greenhouse gasses and thus, contribute to climate change. Securing healthy **ecosystem and tackling climate change** are intrinsically linked. The IPCC Special Report on the impacts of global warming of 1.5°C points out that climate-related risks depend on the rate, peak and duration of warming, and some impacts may be long-lasting or irreversible, such as the loss of some ecosystems. More biodiverse and better connected ecosystems are more resilient to climate change. Many land and ocean ecosystems and some of the services they provide have already changed due to global warming. Approximately 4% of the global terrestrial land area is projected to undergo a transformation of ecosystems from one type to another at 1°C of global warming, compared with 13% at 2°C. In addition, healthy ecosystem significantly contribute to carbon sequestration and storage. Although wetlands occupy only between 5% and 8% of the earth's total land surface, they hold 35% or more of organic carbon that is stored in soils. Yet when such ecosystems are degraded, their role is reversed, and drained or damaged wetlands are a major source of greenhouse gas emissions, with current rates of release of damaged wetlands estimated at nearly 6% of global human CO_2 emissions[65].

Healthy ecosystems are also important for **disaster risk reduction & control** and to reduce the negative impacts, including economic losses. For example, in case of heavy rainfall, functioning floodplains along rivers and wetlands can buffer large amounts of water and thus

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[62] World Economic Forum: The Global Risks Report 2022.
[63] OECD: Biodiversity Finance and the Economic and Business Case for Action.
[64] State of Biodiversity for Food Agriculture (FAO).
[65] Wetland Restoration for Climate Change Resilience, Ramsar Briefing Note 10 (2018).

protect downstream villages and cities from floods[66]. Such ecosystems that act like sponges, can also mitigate the impacts of extreme draught. Coral reefs, seagrass and mangroves protect coastlines from waves and storms. Forested slopes and vegetation help stabilise soil, protecting people and their assets from erosion and landslides. When these ecosystems disappear or degrade, so does their risk-reducing capacity.

The overall poor and degrading condition of ecosystems represents a significant economic risk to society, a problem that is also reported at global level. The recent IPCC 2022 report[6] points out that biodiversity loss, and degradation, damages to and transformation of ecosystems are already key risks for every region due to past global warming and will continue to escalate with every increment of global warming. At the same time, climate conservation, protection and restoration of ecosystems reduces the vulnerability of biodiversity to climate change. Thus, safeguarding biodiversity and ecosystems is fundamental to climate resilient development. Climate change will increasingly put pressure on food production and access, especially in vulnerable regions, undermining food security and nutrition. At the same time **agroecological principles and practices**, ecosystem-based management in fisheries and aquaculture, and other approaches that work with natural processes support food security, nutrition, health and well-being, livelihoods and biodiversity, sustainability and ecosystem services. Thus restoring ecosystems will **be fundamental in helping to combat climate change and also reduce risks to food security.** Over half of **global GDP depends**[67] on nature and the services it provides and more than 75 % of **global food crop types**[68] rely on animal pollination. The in-depth global **Dasgupta Review**[69], on the economics of biodiversity, made an urgent call to ensure that our demands on nature do not exceed its supply, and that we must tackle the nature crisis in conjunction with the climate emergency for the sake of our economies, livelihoods and well-being - and those of future generations.

As documented in the EU 2021 Strategic Foresight Report[70], the cost of these environmental challenges is estimated at EUR 3.5-18.5 trillion per year in ecosystem services from 1997 to 2011, which were lost globally owing to land-cover change, and an estimated loss of EUR 5.5-10.5 trillion per year due to land degradation. There is also a link between between climate change, biodiversity loss, environmental degradation and public health: loss of biodiversity, pressure on animal habitats combined with other factors can make future pandemics or diseases more likely.[71]

The failure to restore ecosystems will also have repercussions for the EU to meet its **international commitments**, as under the Convention on Biological Diversity (CBD), the UN

[66] The European Commission's INCA project estimated the value of flood control by ecosystems in the EU-28 at 18 billion euro (avoided damage cost).
[67] WEF: New Nature Economy Report (2020).
[68] IPBES: Global Assessment.
[69] Professor Sir Partha Dasgupta, final report of the independent review on The Economics of Biodiversity, 2 February 2021.
[70] COM(2021) 750
[71] COM(2021) 750

Convention to Combat Desertification (UNCCD), the UN Framework Convention on Climate Change (UNFCCC) and the Paris Agreement (see 1.1. Political context), and to lead by example. Also the EU's domestic commitments in the EU Green Deal as the new economic strategy, including the climate package with strengthened focus on natural sinks, cannot be delivered on without restoring nature.

Finally, it needs to be recognised that nature is more than an economic good or service[72]: and most EU citizens highly value its very existence and recognise its intrinsic worth, a natural heritage that should be respected and protected on a par with cultural heritage so that it can continue to benefit future generations. Healthy ecosystems present a range of aesthetic, spiritual and restorative values to people, as it became particularly evident during the COVID-19 pandemic, which cannot always be expressed in quantitative or monetary terms[73]. Economic estimates can give some monetary estimates of the value of specific ecosystem services, however as underlined in the Dasgupta review[74] absolute values of nature are likely to be meaningless, since without nature life would cease to exist, and as the review summarises: "economics, when used with care, is meant to serve our ethical values".

2.2. What are the problem drivers?

According to the **State of Nature Report**, the EU Ecosystem Assessment and the **IPBES report**[75], the **main drivers of biodiversity loss and ecosystem degradation** are changes in land and sea use, over-exploitation of natural resources, climate change, pollution and invasive alien species.

The drivers are, to an extent, being addressed by EU legislation such as the Birds and Habitats Directives, the Marine Strategy Framework Directive, the Water Framework Directive and the Regulation on Invasive Alien Species. **However, despite significant effort and some progress, the existing EU legislation has so far not led to a significant recovery of the targeted ecosystems.** The reasons for these failures have been examined[76] and are covered in detail later in this section. Furthermore, not all ecosystems that suffer degradation, such as forests and agricultural ecosystsems, are comprehensively covered by the above-mentioned legislation.

A number of the drivers and pressures on biodiversity are being addressed to a degree by the **actions under the Biodiversity Strategy for 2030** together with other initiatives under the **European Green Deal** (e.g. Zero Pollution, Circular Economy, Farm to Fork, Soil Strategy, Forest Strategy, Adaptation Strategy, climate neutrality), but it is too early for these to show

[72] Dasgupta, P. (2021), The Economics of Biodiversity: The Dasgupta Review. Abridged Version. (London: HM Treasury)
[73] https://www.newscientist.com/article/mg24933270-800-green-spaces-arent-just-for-nature-they-boost-our-mental-health-too/
[74] Professor Sir Partha Dasgupta, final report of the independent review on The Economics of Biodiversity, 2 February 2021, abridged version p. 23
[75] The Regional Assessment Report on Biodiversity and Ecosystem Services for Europe and Central Asia.
[76] See EU Water legislation – Fitness check, Fitness Check of the Birds and Habitats Directives.

results. They will have positive contributions to restoration but on their own, will not be sufficient to meet tangible verifiable restoration objectives (see sections 2.4 and 5.1).

The evaluation of the Biodiversity Strategy to 2020 has also revealed insufficient progress towards restoration. Therefore, there is a significant and specific problem to be addressed, ***the insufficient restoration of degraded ecosystems due to policy and legislative failures,*** which is therefore the focus of this impact assessment.

Specific policy drivers: policy and legislative failures

The main policy failures can be broken down in 1) ineffectiveness of voluntary targets, 2) shortcomings in existing legislation, and 3) lack of a comprehensive and coherent approach.

1) Voluntary targets have been ineffective

In 2011, a key voluntary target of the EU Biodiversity Strategy to 2020 was to restore at least 15 % of degraded ecosystems by 2020. This voluntary target has not been met. The **evaluation study of the Biodiversity Strategy to 2020** identified, among the reasons for the failure in ecosystem restoration, the voluntary rather than legally binding nature of the targets. The subsequent **lack of commitment and political priority for restoration activities** is regarded as a key barrier leading to a lack of financing and resources being allocated to restoration. On the other hand, another target of the Biodiversity Strategy to 2020 on invasive alien species that was made legally binding, with the adoption of a new regulation, did result in this target being implemented to a large extent and in benefits that would not have been delivered if they would have been voluntary[77].

Reasons why the voluntary restoration target has not been met, include:

- Lack of obligation for Member States to act: Despite the guidance[78] developed and the explicit request by the Commission, only a few Member States developed the strategic frameworks to set priorities for ecosystem restoration, and restoration progress has been slow and uneven. The absence of these strategic frameworks has been a barrier to the strategic planning, financing, implementation and monitoring of restoration activities. The fact that the guidance was followed by some Member States suggests that developing such frameworks was feasible. However, in the absence of an obligation and of a linked dedicated EU-level governance framework to steer the process and regularly review progress, most Member States did not follow on the commitment, to deliver such strategic frameworks and to effectively

[77] Report on the review of the application of the Regulation on Invasive Alien Species: COM(2021) 628: *"The IAS Regulation has created a coherent framework for addressing IAS at EU level. It has led most of the Member States to set up a surveillance system and carry out official controls for such species. Despite the very short period of actual full implementation, there are indications that restrictions (e.g. removal of species from trade), early detection/rapid eradication and management of widely spread species deliver benefits."*

[78] Commission Guidance to the Member States in relation to the development and application of a strategic Restoration Prioritisation Framework, 2014, which was based on the study: Priorities for the restoration of ecosystems and their services in the EU, 2014

prioritise restoration, leading to insufficient funding and insufficient restoration effort. This indicates that a stronger and more binding framework is needed with clear targets, resource planning, monitoring and enforcement mechanisms to support strategic planning and implementation and to ensure delivery.

- The formulation of the target as an overall percentage of degraded ecosystems: In the absence of an agreed methodology to comprehensively map, assess, monitor and report on the condition of ecosystems , progress towards reaching the target was not measurable. The **Mapping and Assessment of Ecosystems and their Services**[79] initiative (under Action 5 of the Biodiversity Strategy to 2020) has made progress in developing an EU methodology and enhancing knowledge on the condition of EU ecosystems and their services. However, there are still significant data gaps for certain ecosystems, such as marine, soils, forests, and agro-ecosystems. This has made it impossible for Member States to assess their performance against the voluntary target.
- Biodiversity targets of a voluntary nature were not systematically prioritised for funding in the design and implementation of EU instruments in other policy areas, and measures of low or no positive biodiversity impact were often favoured in national programming.

2) Shortcomings in existing legislation

The evaluation of the Biodiversity Strategy to 2020 and of the main pieces of relevant legislation have revealed implementation problems, reflecting the complexity of the issues at hand. Beyond that, a number of shortcomings remain, since aspects of legislation are **not sufficiently specific, time-bound or measurable to achieve restoration objectives**. For instance:

The **Habitats Directive (HD)** sets an objective to maintain or restore, to favourable conservation status, natural habitats and species of Community interest, **but without deadlines or timeframes, i.e. there are no time-bound targets to reach favourable conservation status**. The **Birds Directive** sets a similar objective for all species of naturally occurring birds in the wild state in the EU, also without a deadline to reach secure status. **Both directives also lack effective requirements to restore habitats outside the Natura 2000 network.** The **Fitness Check of the Birds and Habitats Directives**[80] (2016) found that the directives are fit for purpose, but fully achieving their objectives and realising their full potential will depend on substantial improvement in their implementation. In particular, it found that the lack of precise timelines/targets makes it difficult to fully judge whether progress is in line with expectations, and it is not possible to determine when the general objectives of the directives will be achieved. The pace of implementation of measures towards favourable conservation status has been very slow; action has been concentrated in setting up Natura 2000 sites and to

[79] https://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/index_en.htm
[80] SWD/2016/472 final.

date it has been mainly linked to protection of the habitats and species in the sites, rather than to their restoration. The most frequently reported factors affecting implementation are funding availability, stakeholder awareness and cooperation and availability of knowledge, as well as ineffective integration with other policies.

All in all, this underlines that explicit, well-defined time-bound targets are needed, accompanied by effective enabling measures, including planning, monitoring, reporting and funding.

The **Marine Strategy Framework Directive (MSFD)** sets out a broad goal to achieve good environmental status in EU marine territories by 2020. The 2020 **report from the Commission on the first implementation cycle of the directive**[81] concludes that progress in reaching good environmental status has not been fast enough. **In particular, the broad goal of the Marine Strategy Framework Directive has proven very difficult to achieve;** the reasons for that include the lack of specific measures, **lack of sufficiently fine-grained monitoring of specific habitats or species**, coupled with **a lack of specific focussed targets**. This does not cater for, and hinders, the needed specific restoration measures for specific habitats or species, that need to be rapidly addressed.

The **Water Framework Directive (WFD)** sets out an obligation to restore all water bodies to good status by 2015, with the latest deadline by 2027. The **Fitness Check of the Water Framework Directive and Floods Directive**[82] (2019) concluded that the Water Framework Directive is broadly fit for purpose. However, the objective of reaching good (ecological and chemical) surface water status has not been reached – only 40 % of water bodies are in good ecological status. This difficulty in implementation is in part due to the fact that the water body condition is affected by diffused pollution (e.g. nitrates and pesticides) coming from surrounding habitats (the catchment). These, if restored and protected, would help accelerate progress. Another factor is that the WFD does not necessarily require the removal of barriers that may disrupt the natural connectivity of a river/lake system (only where this would be required to achieve good status and with possible exemptions where justified). However, many terrestrial ecosystems, such as wetlands and floodplains and several habitats and species protected by the Birds and Habitats Directives, directly depend on the aquatic ecosystems being in near natural conditions (free-flowing state). Thus, the **WFD may not be sufficiently equipped to guarantee such natural connectivity to the extent necessary to sustain these habitats and species and guarantee thriving floodplains.** Furthermore, while the WFD addresses all waters in the EU, the methodologies prescribed to delineate the water bodies, which are the units of measures for compliance checks, are such that smaller rivers or lakes below a certain size threshold may in practice not be fully addressed. These shortcomings can be addressed with supplementary restoration requirements.

[81] Report from the Commission to the European Parliament and the Council on the implementation of the Marine Strategy Framework Directive (Directive 2008/56/EC) COM/2020/259 final.

[82] Trinomics B.V., *Final evaluation report*, European Commission- DG Environment, Service request under framework contract ENV.F.l/FRA/2014/0063, Rotterdam, October 2019.

3) Lack of a comprehensive approach

Ecosystems underpin much of our livelihoods, yet there is a lack of a policy approach to deal with the broad range of ecosystems in a comprehensive manner. Ecosystems are dealt with separately by different pieces of legislation, which has resulted in some **challenges in coordinated implementation.** Although there are differences in their objectives, the Birds and Habitats Directives (BHDs), the Water Framework Directive (WFD), and the Marine Strategy Framework Directive (MSFD) are generally coherent with each other and mutually reinforcing. The Fitness Check of the BHD has nevertheless revealed some challenges in implementation that need to be addressed. This is particularly relevant where these Directives interact, for example water bodies whose status depends on their surrounding riparian habitats, and should be dealt with in an integrated way to achieve specific restoration objectives, such as for flood plains.

Moreover, there are habitats/species/ecosystems that are not or insufficiently covered by legislation. While the Birds Directive aims to protect all wild bird species and their habitats across the EU, its most specific provision on habitat protection (Article 4) only concerns bird species listed in Annex I of the directive as well as regularly occurring migratory species not listed in Annex I. For those species, Member States must set up Special Protection Areas which form part of the Natura 2000 network. The provision concerning the preservation and restoration of the habitats of all bird species (Article 3) provides a general obligation which is largely not implemented. Hence, many **bird habitats** are, in practise, not subject to protection and restoration measures.

The Habitats Directive (HD) covers 1 200 threatened or endemic species of wild animals and plants, collectively referred to as species of Community interest (listed in its Annexes II, IV and V), as well as 231 rare habitat types, listed in its Annex I. Its provisions that are most relevant for restoration mainly relate to Annex I habitats as well as habitats of the species listed in Annex II within Special Areas of Conservation (part of the Natura 2000 network). For those Annex I habitats and habitats of Annex II species that are located outside Natura 2000, **there is no specific provision on restoration**, albeit the achievement of the directive's objective would require this to happen. The same goes for species listed in Annex IV and V of the directive, for which no specific habitat restoration provisions are set, in spite of the objective to maintain or restore them, at favourable conservation status. Moreover, for habitats of the protected species which do not overlap with Annex I habitats, the restoration requirements only concern the necessary action to address the ecological requirements of the protected species, including birds, while there is no requirement to implement restoration for any other purposes.

The Natura 2000 network on land currently covers 18% of the EU surface (764 000 km^2)[83], ranging from 8,3% in Denmark to 36,7% in Croatia, which reflects differences in biodiversity richness but also different designation strategies by the Member States. The network covers

[83] https://www.eea.europa.eu/data-and-maps/dashboards/natura-2000-barometer

approximately 34% of the surface of all Annex I habitat types, which means that about two thirds lies outside.

Therefore, it can be concluded that – as regards the Habitats and Birds Directives - the areas for which there is no effective provision on restoration cover all land and sea that do not fall within Natura 2000 sites, i.e. the majority of the EU territory, large parts of which are undergoing continuous degradation (EU Ecosystem Assessment 2020).

Although protection and restoration of habitats (e.g. peatlands) under the Birds and the Habitats Directive will benefit soil health and soil biodiversity, this is not an explicit objective of the Directives. **Soil health and soil biodiversity** are not yet covered by EU legislation in an explicit comprehensive and coherent manner. As stated in the State and Outlook of the Environment Report 2020 (EEA): "*The lack of a comprehensive and coherent policy framework for protecting Europe's land and soil resources is a key gap that reduces the effectiveness of the existing incentives and measures and may limit Europe's ability to achieve future objectives related to development of green infrastructure and the bioeconomy"*. The legislative proposal ('Soil Health Law') announced in the recently adopted EU Soil Strategy for 2030[84] is expected to address this. For these reasons, soil-related legal obligations will be taken up in that proposal. Furthermore, although some **pollinators** are protected under the Habitats Directive (e.g. rare butterfly species) and they also benefit from habitat conservation measures (e.g. for grasslands) they are not a particular focus of the Nature Directives. Finally, there is no EU legislation requiring the restoration of **urban ecosystems**.

The key policy and legislative failures can be summarised as follows:

1) **Voluntary targets have not been effective** and have not led to the achievement of the agreed EU voluntary restoration targets in the EU Biodiversity Strategy to 2020.
2) There are **significant shortcomings and gaps in existing legislation to address restoration effectively** (for example there are no terrestrial time-bound targets, there is a lack of specific provisions on restoration, etc).
3) **Many ecosystems are not covered** by legislation, and are degraded, **representing significant areas** of the EU territory. This includes soils and some forests, grasslands and urban ecosystems. Furthermore, **key species groups such as pollinators are not covered** by legislation.
4) **The lack of a common methodology** for assessing ecosystem condition for these ecosystems not covered by existing legislation blocks progress since condition cannot be measured consistently.

Whilst better implementation of existing legislation would improve the situation, it would not be sufficient to address the problem of reversing the trend of biodiversity loss and restoring ecosystems. To address the policy gaps and shortcomings mentioned above, new legislation is needed. This should supplement the existing legal instruments to protect nature, with additional means to restore nature in order to reverse these downward

[84] COM(2021) 323

trends. In other words, to halt and reverse biodiversity loss, protection of nature needs to be supplemented by more efforts to restore degraded ecosystems. The new legislation should build on and work in synergy with existing legislation, but go further to ensure that restoration can be addressed explicitly and extensively across the EU.

2.3. Who is affected by the problem?

The poor condition of ecosystems and the decline of biodiversity impacts on the whole of society, through the loss of ecosystem services, which support economic activity and human livelihoods. The World Economic Forum has identified biodiversity loss as the third most pressing global risk by severity for the next decade, after climate action failure and extreme weather[85]. Biodiversity loss has critical implications for the whole population, from the collapse of food and health systems to the disruption of entire supply chains. Over half of global GDP depends on nature and the services it provides, with three key economic sectors – construction, agriculture, and food and drink – all highly dependent on it[86]. The Banque the France found that 42% of the market value of securities held by French financial institutions comes from issuers (non-financial corporations) that are highly or very highly dependent on at least one ecosystem service[87].

The degradation of ecosystems particularly affects farmers, foresters, landowners, fishers, the water sector and agri-food sectors, the insurance sector (increased impact of disasters), the financial sector (investments dependent on biodiversity) and the tourism sector. At the same time society as a whole also stands to gain significant benefits once ecosystem health is improved.

The **OECD estimates**[88] that the world lost EUR 3.5-18.5 trillion per year in ecosystem services from 1997 to 2011 owing to land-cover change, and an estimated EUR 5.5-10.5 trillion per year from land degradation. Although figures for the EU were not specifically calculated, one can deduce corresponding losses for the EU. Soil erosion costs European countries and farmers EUR 1.25 billion per year solely in loss of agricultural productivity[89].

Furthermore, biological diversity of microorganisms, flora and fauna also provides extensive benefits for biological, health, and pharmacological sciences. Loss in biodiversity would limit discovery of potential treatments for many diseases and health problems. Loss of biodiversity

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[85] Global Risks Report 2022, World Economic Forum, WEF: https://www.weforum.org/reports/global-risks-report-2022

[86] World Economic Forum (2020), Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy: http://www3.weforum.org/docs/WEF_New_Nature_Economy_Report_2020.pdf

[87] Banque de France (2021), Working Paper Series no. 826: A "Silent Spring" for the Financial System? Exploring Biodiversity-Related Financial Risks in France.

[88] *Biodiversity: Finance and the Economic and Business Case for Action*, report prepared by the OECD for the French G7 Presidency and the G7 Environment Ministers' Meeting, 5-6 May 2019.

[89] Panagos et al., *Cost of agricultural productivity loss due to soil erosion in the European Union*, 2018.

including pollinators in agricultural soils is also a threat to food production and food quality affecting farmers and citizens alike.

Moreover, there are costs of at least EUR 169 billion per year due to poor management of oceans such as over-exploitation of fisheries, nutrient pollution and invasive marine species carried in ship ballast water.[90]

Degraded ecosystems also have a reduced capacity to mitigate and adapt to climate change, so that people and nature will face more severe consequences such as heat, drought, wildfires, floods and other disasters, when ecosystems continue to decline.

However, biodiversity conservation and nature restoration can avoid many of these costs. They have potential direct economic benefits for many sectors of the economy. For example, conserving marine stocks could increase annual profits of the seafood industry by more than EUR 49 billion, while protecting coastal wetlands could save the insurance industry around EUR 50 billion annually through reducing flood damage losses.[91]

In addition, the Nature Fitness Check[92] showed that the benefits of Natura 2000 are valued at between EUR 200-300 billion per year. The investment needs of the network are expected to support as many as 500,000 additional jobs.[93] For example in the forestry sector a first estimate suggests that Natura 2000 supports 73,000 jobs.[94]

Box 1: Views of stakeholders and authorities on the problem, its impacts and drivers in the EU:

A series of Eurobarometer surveys[95] over the past years indicate that the overwhelming majority of European citizens consider the various effects of biodiversity loss to be serious for humans and for nature, and agree that it is important to halt its loss (eight out of ten in the last survey published in 2019). The biggest perceived threats to biodiversity are pollution of air, soil and water, man-made disasters and climate change. EU citizens overwhelmingly agree that nature protection areas are very important and they are not willing to trade damage or destruction of protected areas for economic development.

An open public consultation on the evaluation of the EU Biodiversity Strategy to 2020, carried out jointly with the public consultation on the nature restoration targets, explored the drivers as well as impacts on stakeholders from the failure to halt biodiversity loss. A key reason for failure noted by stakeholders in open text responses related to the lack of

[90] UNDP and GEF (2012), Catalysing Ocean Finance Volume I Transforming Markets to Restore and Protect the Global Ocean United Nations Development Programme, http://www.thegef.org (accessed on 29 March 2019).
[91] Barbier et al. (2018), How to pay for saving biodiversity. (see BDS2030 chapter 1)
[92] Fitness Check of the EU Nature Legislation (SWD (2016) 472).
[93] Member States' Prioritised Action Frameworks 2020; Mutafoglu et al. (2017), Natura 2000 and Jobs: Scoping Study
[94] Member States' Prioritised Action Frameworks 2020; Mutafoglu et al. (2017), Natura 2000 and Jobs: Scoping Study
[95] https://www.eea.europa.eu/data-and-maps/indicators/public-awareness-2/assessment

integrated, holistic approaches to halting biodiversity loss. EU citizens and academic/ research institutions noted that conflicts can arise in the management of biodiversity predominantly due to contrasting approaches between Member States' and EU/international decision making and diverging economic interests amongst actors in implementing biodiversity-related measures. Furthermore, a 'lack of enforceability' of the Strategy was regarded as a reason for failure by some stakeholders (EU citizens and an academic), followed by poor definition of the targets. Asked about impacts on themselves or on their field of work, more respondents identified significant impacts since 2011 (48%) compared to those who did not identify impacts (33%).

In the open public consultation and consultation workshops on the definition of nature restoration targets, stakeholders from environmental organisations pointed to the voluntary nature of the restoration target in the past as a reason for the failure to implement it. The majority of respondents in the Open Public Consultation who 'completely disagreed' that the voluntary nature of the target had undermined its delivery were forestry-related. The majority of stakeholders who 'fully agreed' or 'tended to agree' that unresolved conflicting land use interests were a factor belonged (in decreasing order) to the forestry, environment and culture sectors. The lowest number of respondents considered that insufficient knowledge and skills had been a barrier. Insufficient funding and conflicting land use interests were the answers most often selected by forestry sector stakeholders.

How the views of stakeholders and authorities have been taken into account:

The problems and drivers identified by the stakeholders are taken into account in this impact assessement and are addressed by the proposed policy option. Threats such as pollution are largely being addressed by other EU initiatives and legislation, however, nature restoration will in many cases also entail reduction of (the impacts of) pollution, and will, in turn, contribute to cleaner water and air. The EU proposal on restoration targets will provide for a more harmonised approach in the EU, with objectives which are in line with international ambitions and commitments. The synergies with and added value to existing legislation, such as the Birds and Habitats Directives, the Climate Law and the LULUCF Regulation, will ensure the called-for integrate approach. The lack of enforceability and poor definition of targets, as well asl their voluntary nature, is addressed by this proposal as it sets specific, binding targets with clear deadlines and reporting obligations. The issue of conflicting land use interests will be (at least partially) addressed by enabling measures, for instance by pointing towards financial opportunities at EU-level e.g. for developing alternative incomes based on the provision of ecosystem services.

2.4. How will the problem evolve?

As described in Chapter 2, biodiversity loss and degradation of ecosystems continues in the EU, and the restoration efforts to improve the condition of ecosystems have been largely insufficient.

Halting all greenhouse gas emissions would still not prevent the impacts of climate change that are already occurring. These will continue for decades, even if global and European efforts to cut greenhouse gas emissions prove effective. Studies suggest that up to half of Europe's land area may experience major climate-induced changes during this century[96,97]. Marine ecosystems and the oceans are also projected to change significantly[98].

Estimates of how the problem will evolve are also described in the **evolution of the baseline** for each main ecosystem type in the thematic assessments in Annex VI. Annex VII provides a description of the trends of the baseline in broad terms.

The initiatives under the Biodiversity Strategy for 2030 and under the European Green Deal (see Chapter 1) can help to tackle several of the drivers and pressures of ecosystem degradation, and the set of existing and upcoming policy measures of the Green Deal can be expected to help ecosystems to recover to a small degree, for instance by contributing to passive restoration, for instance by reducing pollution or reducing over-exploitation (see policies and their relevance to restoration in Annex X). However, the analysis of their overall impacts indicates that this does not sufficiently address the problem (Annex VII see baseline) and extensive restoration will not be achieved by these policies. Many degraded ecosystems require focussed and location-specific passive restoration measures, as well as a range of location-specific active restoration measures. All of these are needed for ecosystems to recover. **Thus, without significant intervention, the problem of the lack of restoration will continue and persist across the EU.**

Biodiversity and ecosystems and the need to restore nature is at the core of the Green Deal, and the economic transformation of the Green Deal goes hand in hand with having healthy ecosystems. Failure to address the problem of restoration will pose risks to addressing core objectives of the Green Deal, including reaching climate neutrality. EU climate policy is increasingly relying on natural sinks to capture and store carbon (such as in the LULUCF Regulation). Ecosystems, such as wetlands or forests, need to be in a heathy state in order to be able to effectively capture and store carbon. Likewise, more biodiverse and healthy ecosystems are more resilient to climate change and also provide more effective form of disaster reduction and prevention. Healthy croplands and grasslands, rich in biodiversity and

[96] Samuel Hoffmann, Severin D. H. Irl & Carl Beierkuhnlein, *Predicted climate shifts within terrestrial protected areas worldwide*. Nature Communications vol 10 N° 4787, 2019.

[97] Hickler et al., *Projecting the future distribution of European potential natural vegetation zones with a generalized, tree species-based dynamic vegetation model*, Global Ecology and Biogeography, 2012, pages 21, 50–63.

[98] https://www.ipcc.ch/srocc.

pollinators are needed in order to assure crop provision in terms in quantity and quality, and without these **the likely evolution of the problem would increase the likelihood of not reaching objectives of strategies of the Green Deal** such as the Farm to Fork Strategy.

In summary, because of the various shortcomings and gaps in the existing legislation as described above, this will not by itself be able to drive a restoration agenda. **In the absence of binding restoration targets and proper planning, monitoring, reporting and enforcement mechanisms, the problem of poor ecosystem condition risks to be further aggravated. This would also significantly hamper reaching the objectives of the Green Deal.**

3. WHY SHOULD THE EU ACT?

3.1. Legal basis

The legal basis is Article 192(1) of the Treaty on the Functioning of the European Union. On the basis of this provision, the Union can take action to achieve the objectives of Article 191: Union policy on the environment shall contribute to pursuit of the following objectives:

- preserving, protecting and improving the quality of the environment,
- protecting human health,
- prudent and rational utilisation of natural resources,
- promoting measures at international level to deal with regional or worldwide environmental problems, and in particular combating climate change.

3.2. Subsidiarity: necessity of EU action

Intervention at EU level is justified in view of the scale and transboundary nature of biodiversity loss and ecosystem degradation, the impacts of environmental degradation on citizens across the Union as well as the risks to its economy. Coordinated measures by all Member States are necessary to achieve significant levels of biodiversity and ecosystem restoration in the EU. The roll out of the Biodiversity Strategy to 2020 has shown that the voluntary commitments of Member States are not sufficiently conducive to reaching EU objectives for restoring ecosystems.

Moreover, given that several ecosystems are already covered by EU legislation, EU action is needed to complement existing requirements where necessary and to fill policy gaps for ecosystems that are not yet fully covered.

3.3. Subsidiarity: added value of EU action

- Coordinated action is needed at a sufficiently large scale to address biodiversity loss and degradation and to benefit from synergies at that level. The more ecosystems are restored, the greater their capacity to reverse the decline of species and habitats. Working at European scale is essential, for instance for the recovery of birds and pollinators which is a problem across the EU and cannot be solved by only working in some Member States. Likewise, addressing problems at European scale is also essential given the extent of mobility of many terrestrial/aquatic/marine species and for addressing pressures such as aquatic and air pollution. In terms of synergies, restoring one ecosystem has positive effects on other neighbouring or connected ecosystems and their biodiversity, since many species thrive better in connected networks of ecosystems on a large geographical scale.

- EU-level action allows to address the transboundary nature of biodiversity-related and ecosystem degradation issues, including the pressures on ecosystems, which could not be tackled efficiently at Member State level alone. EU-level action brings effectiveness/efficiency gains.
- EU-level action is also needed to ensure a consistent approach to restoring towards good ecosystems condition across the EU. Without this there would be no common targets of what restoration efforts are aiming towards.
- Taking ambitious, coordinated action on biodiversity and ecosystem restoration at EU level, will give the EU the necessary credibility to 'lead by example and by action' at international level.
- Further analysis of subsidiarity for each of the policy options is presented in Chapter 7.

Box 2: Views of stakeholders and authorities on the need for EU action.

The feedback received on the ***Inception Impact Assessment roadmap*** *(see Annex II for more analytical detail) revealed overall broad support for the EU initiative across NGOs, academia, business, citizens and other organisations. Some environmental NGOs and experts proposed that EU legislation should set binding targets for the individual Member States. However, most respondents (across stakeholder groups) considered that the selection of restoration sites and measures should be done at the national and sub-national level, and that the governance, monitoring and reporting framework should provide for this flexibility.*

Stakeholder views expressed in the open public consultation diverged significantly as concerns the ***level at which targets should be set****. When all responses were considered, there was close to full support both for an overarching restoration goal (97%) and for specific targets for ecosystems (96%). When the responses submitted via the #RestoreNature campaign were isolated, none of the options for binding EU restoration targets received majority support. Stakeholders active in the forestry sector in Poland, who formed the majority of these respondents (55%), indicated relatively low support for an EU level target across all ecosystems (40%) and even lower support for ecosystem-specific EU restoration targets, while open responses indicated preference for the setting of targets at the national level and called for financial incentives. Open text respondents overwhelmingly supported subsidiarity for the Member States to determine restoration priorities, pointing to local* *social, historical and cultural knowledge, differences in economy and policy structures and biodiversity and ecosystems. A combined approach of EU restoration targets and Member States' flexibility to plan restoration on the ground according to national features was broadly supported by Member States' authorities and stakeholders at the consultation workshops.*

How views of stakeholders and authorities have been taken into account:

The proposed policy option sets targets for Member States, but the prioritisation of restoration sites and selection of measures is left to Member States, in line with the principle of subsidiarity and allowing for flexibility in planning and to accommodate for local conditions. A combined approach is proposed, setting both an overarching restoration target as well as a range of ecosystem-specific targets.

4. OBJECTIVES: WHAT IS TO BE ACHIEVED?

4.1. General objective

The general objective is that the EU's biodiversity should be on the path to recovery and that all EU ecosystems should be restored.

This general objective is in line with the Biodiversity Strategy for 2030 and supported by other initiatives under the European Green Deal. This general objective is at a level consistent with Article 192(1) of the Treaty on the Functioning of the European Union (see section 3.1 above). The implementation of the strategy is in progress, with a large number of specific actions being carried out.[99] The more ecosystems are restored the greater their capacity to revert the decline of species and habitat types, thereby avoiding extinctions and regaining habitats and species in what is their natural range. In addition, the more biodiverse and better connected ecosystems we have, the greater is their capacity to adapt to climate change (by allowing species to migrate northwards and upwards) and the greater the overall resilience of Europe's nature to predicted weather extremes. In addition (and as important), the more we restore ecosystems that capture and store carbon, the more contribution there is to climate policy in terms of climate adaptation and mitigation. Ecosystem restoration is an essential part of climate policy and vice versa:

[99] Details of the implementation plan and progress are publically available through the online EU Biodiversity Strategy Actions Tracker and the EU Biodiversity Strategy Dashboard.

climate adaptation and mitigation is needed to prevent further biodiversity loss and ecoystems degradation. This should apply to all regions of the EU including the outermost regions[100, 101].

4.2. Specific objective

Following from the general objective, the specific objective is:

To restore degraded ecosystems across the EU, in particular those that have the most potential to remove and store carbon and prevent and reduce the impact of natural disasters; and to restore the broad range of ecosystems in the EU, with restoration measures in place by 2050 and ecosystems on the path to recovery by 2030.

For the specific objective, one should note that:

1. The primary objective is an ecological one (i.e to improve the condition of ecosystems). However, improved ecosystem condition also goes hand in hand with the delivery of a range of ecosystem services that result from improved condition. Thus, the **specific objective will naturally entail the improvement of a wide range of ecosystems services, of which climate mitigation and disaster risk reduction are particularly highlighted.** The emphasis given to restoration that in particular contributes to climate mitigation and disaster risk reduction was specified in the Biodiversity Strategy to 2030.

2. To define the **breadth of ambition** and **set dates** for progress for the specific objective, further reference to the biodiversity strategy has been made. The strategy specifies that the EU's biodiversity will be on the path to recovery by 2030, and that by 2050 all ecosystems are restored. **Given that in practice it may not be possible to restore *all* ecosystems, the specific objective needs to address at least "a broad range" of ecosystems[102] in the EU.** Furthermore, given the dates specified in the Biodiversity Strategy, **ecosystems should be restored by 2050 and on the path to recovery by**

[100] Scattered across the Atlantic Ocean, the Caribbean sea, Latin America and the Indian Ocean, the nine EU outermost regions - Guadeloupe, French Guiana, Martinique, Mayotte, Reunion Island and Saint-Martin (France), the Azores and Madeira (Portugal) and Canary Islands (Spain) - face permanent constraints due to their remoteness, small size, insularity, and have the highest EU unemployment rates and some of the lowest GDP rates. It is in this context that the Treaty on the Functioning of the European Union (Article 349 TFEU) provides for specific measures to support the outermost regions, including derogations on the application of EU law in these regions.

[101] The Biodiversity Strategy for 2030 foresees that "*particular focus will be placed on protecting and restoring the tropical and sub-tropical marine and terrestrial ecosystems in the EU's outermost regions given their exceptionally rich biodiversity value*".

[102] It may not be possible to restore all ecosystems, but at least a broad range should be restored. For example, some very heavily modified ecosystems due to human or climate change causes may not be possible to fully restore.

2030. This sets the breadth of ambition of the specific objective and provides milestones dates for progress for the specific objective.

3. The **"broad range" of ecosystems** to be addressed is taken to correspond to the main ecosystem types in the EU: **wetlands, forests, agro-ecosystems (including grassland and cropland), marine ecosystems, heathland, scrub, rocky and dune habitats (which encompasses sparse vegetation), lakes, rivers and alluvial ecosystems and urban ecosystems.** Carrying out restoration of these ecosystems would help improve their condition and restore biodiversity. Restoration of these ecosystems would also typically, and to varying degrees depending on the specific restoration carried out, contribute to removing and storing carbon and preventing and reducing the impact of natural disasters. The marine and terrestrial ecosystems in the EU's outermost regions (including tropical and sub-tropical) are also included given their exceptionally high biodiversity value.
4. The **condition** towards or to which most ecosystems need to be restored – "good condition" – means a state where the key characteristics of an ecosystem, namely physical, chemical, compositional, structural and functional state, and landscape and seascape characteristics, reflect the high level of ecological integrity, stability and resilience necessary to ensure the long-term maintenance. For habitat types listed in Annex I and II the condition is assessed via the "structure and functions" parameter, as referred to in Article 1(e) of the Habitats Directive. Under the Nature Directives, Member States have elaborated for Annex I habitats what a good condition is and how it is monitored in their specific biogeographical circumstances. The result of the monitoring is reported , as part of the Conservation Status assessment under Art.17 of the Habitats Directive to the Commission every 6 years.
5. Restoration of ecosystems does not require to achieve a certain historic condition (e.g. cities don't have to be reverted back into wetlands or forests, biodiverse grasslands do not have to be converted into forests, etc.) but it considers current and predicted changes in environmental conditions. In the case of re-establishment of ecosystems, Member States would be expected to identify (where possible) where ecosystems were lost in the last 70 years in order to take this information into account when drafting their restoration plans and planning the areas of ecosystems to be re-)established. This does however not mean that they have to re-establish a situation as it was 70 years ago.
6. **For ecosystems currently not covered by the Nature Directives, good condition will be defined by the EU-wide methodology to be set up in the context of the Nature Restoration Law** implementation (as explained in 5.2.2 under 'EU-wide methodology').
7. Restoration not only includes measures to improve the condition of the ecosystems but also their **re-establishment**, in particular but not exclusively in the areas where they were lost.
8. One needs to also ensure that restored ecosystems and all others subject to the specific objective be **maintained** and do **not (further) deteriorate** (for example by ensuring protection or appropriate management). Restoration approaches need to take into

account the fact that future restored ecosystems should be **climate-resilient**.

In order to put EU's nature on the path to recovery by 2030, the initiative needs **to act with urgency and lead to measurable results by that date.** However, since data (e.g. on condition) and monitoring mechanisms are not available for all ecosystems, these would need to be developed based on a **step-wise approach**. This is described further in 5.2.1 in more detail; see also Figure 6.

The specific objective would **apply directly to Member States**, taking into account Member States' bio-geographical characteristics, as not all ecosystems are represented in each Member State (see Annex VIII for geographical distribution and condition per Member State). At EU level we would aim to reach the specific objective EU-wide and at Member State level we would aim to ensure that the appropriate efforts are put in place that will jointly help achieve the EU-level objective. Such appropriate efforts are later described in section 5.2.2 which outlines the implementation framework and the requirements placed on Member States for the options considered.

To ensure a good understanding of the objectives and the targets, it is important to note the difference between "**restoration**" and "**recovery**" (as outlined in the Glossary): To restore means that all the necessary measures (e.g blocking of wetlands drainage, re-introduction of needed species, etc.) have been put into place to enable the recovery of an ecosystem to get back to **good condition.** However, some ecosystems can take decades to recover even if all the restoration measures have been put into place. Thus, restoration measures can be put into place relatively quickly, but recovery to good condition can take more time to arrive at, depending also on the type of ecosystem.

Box 3: Views of stakeholders and authorities on the general and specific objectives.

*Restoration for **biodiversity improvement** was considered moderate to high priority for the majority of respondents in the Open Public Consultation, as were the additional objectives of **climate mitigation**, **adaptation** and **resilience**, **disaster risk reduction**, **air and water regulation**, **pollination**, and **human health**. Open question responses from academic and research organisations and some sector stakeholder organisations further stressed the importance of an integrated strategy to support ecosystems restoration and socio-economic development.*

*National authorities, restoration experts from the academia and environmental NGOs participating in the **consultation workshops** underlined the importance of **reducing pressures** and **increasing ecological connectivity**. Several environmental NGOs and restoration experts called for ensuring non-deterioration of both ecosystems that are restored, and those that are to be restored. Stakeholders ranging from national authorities in the Member States and NGOs to sector associations underlined the importance of* *ensuring links and complementarity with the objectives existing EU legislation and policies such as the BHD, WFD, MSFD, CFP, CAP and LULUCF.*

How views of stakeholders and authorities have been taken into account:

The stakeholder feedback on connectivity and on non-deterioration has led to explicit incorporation of both principles (as requirements) in the proposal. Links and complementarity with existing EU legislation is also built in the proposal, for instance to limit the burden on Member States for monitoring and reporting (no duplication) and to ensure added value of the proposal.

Operational objectives:

Following from the specific objective, and the rationale described in section 2.2, the operational objectives are to:

- Restore and maintain ecosystems to good condition by establishing *legally binding nature restoration targets*, in a way that complements existing relevant instruments and fills EU policy and legal gaps. The targets should be 'SMART', i.e. specific, measurable, achievable, realistic and time-bound.
- Ensure that targets are properly implemented by establishing an *effective implementation framework* that includes requirements for monitoring, assessment, planning, reporting, enforcement, financing and capacity building, and when necessary, remedial or corrective action.

Legally binding targets and an associated implementation framework are considered to be the appropriate instruments to fill the **gaps identified in the problem definition** because they would directly address the persisting restoration gaps as well as underlying policy and legislative failures outlined in section 2.2.

Box 4: Views of stakeholders and authorities on the operational objectives:

The Open Public Consultation results overwhelmingly supported the establishment of ***legally binding restoration targets*** *(97 % in favour of general EU-level restoration targets across all ecosystems, 96 % for targets per ecosystem or habitat, 97 % for 'other' and 1 % for targets per species or group of species). The majority of this support was mobilised via the #RestoreNature campaign initiated by environmental NGOs, which included more than 95 % of the EU citizens participating in the consultation. Another specific segment of respondents, mostly citizens and stakeholders active in the Polish forestry sector, expressed preference for* ***soft measures****. The majority of all respondents supported EU action to* *improve knowledge and training, as well as cooperation with EU neighbours to restore cross-border ecosystems.*

At the consultation workshops, calls were made by authorities and stakeholders across the board to ensure support for restoration with enabling measures, with a special emphasis on funding (including compensation), as well as for measures to support community-led ecosystem restoration and management, knowledge, monitoring and research into the impacts of restoration. Passive restoration as well as measures to protect restored ecosystems and to ensure their non-deterioration and sustainable management were considered essential by restoration experts.

How views of stakeholders and authorities have been taken into account:

The proposal includes legally binding targets, both at an overarching level, as well as ecosystem-specific targets. In response to the need for 'soft measures' and 'enebling measures', such enabling measures have been included in the proposal. The impact assessment has shown, that soft (non-binding) measures alone would be insufficient to achieve the restoration objectives of the Biodiversity Strategy. Passive restoration as well as measures to ensure the non-deterioration of ecosystems have been included in the proposal.

4.3. Intervention logic

	Policy and legal context	Drivers	Problem	Objectives	Policy options
General Corresponding to the general objective of the Biodiversity Strategy for 2030.	• European Green Deal; • EU Biodiversity Strategy; • Existing legislation to protect and restore biodiversity and ecosystems such as the Bird and Habitats Directive, Water Framework Directive and the Marine Strategy Framework Directive; • Related EU initiatives, e.g. Farm to Fork, revision of Regulation on land use, land use change and forestry (LULUCF); • Strong public interest in nature restoration.	**Main drivers of biodiversity loss and ecosystem degradation:** • Changes in land & sea use; • Over-exploitation of natural resources; • Climate change; • Pollution; • Invasive alien species.	**General problem:** Biodiversity loss and ecosystem degradation.	**General objective** • EU's biodiversity is on the path to recovery; and • all EU ecosystems are restored.	
Specific Corresponding to the proposal for legally binding restoration targets		**Specific policy drivers: policy and legislative failures:** • Voluntary approaches have been ineffective. • Gaps in existing legislation; • Lack of a comprehensive approach; • Funding challenges; • Political commitment and ownership by Member States.	**Specific problem:** Ecosystem restoration efforts have been insufficient so far. Need for more ambitious nature restoration to reverse biodiversity loss, as nature protection alone is insufficient.	**Specific objective:** To restore degraded ecosystems across the EU, in particular those that have the most potential to remove and store carbon and prevent and reduce the impact of natural disasters. **Operational objectives:** • Restore and maintain ecosystems to good condition by establishing legally binding nature restoration targets. • Ensure that targets are implemented by establishing an effective implementation framework.	**Option 1:** Baseline scenario. **Option 2:** Overarching legally binding target for ecosystem restoration. **Option 3:** Specific targets for ecosystems, habitats or (groups of) species. **Option 4:** Hybrid of an overarching objective and ecosystem-specific targets. + Enabling measures.

5. WHAT ARE THE AVAILABLE POLICY OPTIONS?

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5.1. What is the baseline from which options are assessed?

The baseline scenario assumes the implementation of the Green Deal and Biodiversity Strategy for 2030 *with the exception of the legally binding restoration targets*. Beyond that, the baseline also assumes that other EU and Member State policies relevant to restoration would be implemented. Information on national restoration policies is provided in Annex XI.

The baseline scenario would therefore include:

- Non-binding targets included in the EU Biodiversity Strategy to 2030 related to restoration, such as: no deterioration in conservation trends and status of all protected habitats and species by 2030 and that at least 30% of species and habitats not currently in favourable status are in that category or show a strong positive trend by 2030; 25 000 km of rivers is restored to be free-flowing; by-catch of species threatened with extinction is eliminated or reduced to a level that allows full recovery; and a reverse in the decline of pollinators.
- Broad commitments for financing for biodiversity as well as potential market-based instruments and voluntary approaches to remove harmful subsidies (as outlined in the Biodiversity Strategy for 2030).
- Implementation of relevant EU policies and legislation, particularly the BHD, MSFD, WFD and those under the European Green Deal such as the Zero Pollution Action Plan, the Soil Strategy and Chemicals Strategy, the Fit for 55 Package (mainly LULUCF), the Climate Law, the proposed revision of the Renewable

Energy Directive (RED) and the proposed Regulation on deforestation and forest degradation[103].

- Implementation of national policies relevant to restoration.

For the baseline scenario, we interpret "implementation" of relevant policies, voluntary commitments and legislation as "realistic", based on expected implementation by Member States and based on experience to date (which has shown that implementation has not been perfect and with many insufficiencies). So specifically, it considers the "realistic" implementation of BHD, WFD, MSFD and climate laws (see Annex VII).

Contribution of existing EU legislation and initiatives (see Annex VII for more details)

The 'realistic' implementation of relevant EU environmental and climate legislation will contribute to the recovery of degraded ecosystems by addressing the drivers of biodiversity loss and ecosystem degradation.

The Birds and Habitats Directives **(BHD)** are expected to see enhanced implementation towards 2030 as a result of the efforts resulting from the implementation of the Action Plan for nature, people and the economy that was developed following a thorough Fitness Check of the legislation. Following the completion of the Natura 2000 designation process on land, Member States are in the decisive phase of developing site-specific conservation objectives and measures (including restoration) which are critical to yield results on the ground. The Water Framework Directive **(WFD)** is also expected to see enhanced implementation in light of the deadline to achieve good status of water bodies by 2027, and the Fitness Check that identified some priorities for better implementation. There is, however, little likelihood that Marine Strategy Framework Directive (**MSFD)** implementation will improve towards 2030, as there are several implementation challenges for which it is too early to tell how effectively they will be tackled in the ongoing review. Moreover, the benefits of the review are unlikely to be felt in the short term.

With the **European Green Deal**, biodiversity has become a political priority at the highest political level in the EU. The EGD sets out a strategy for a wide range of initiatives that have the potential to address some of the biggest drivers in ecosystems degradation. The **Climate Law** legally commits all Member States to achieve climate neutrality by 2050. To get on track towards this goal, the **Fit for 55** package sets the EU on course to cut greenhouse gas emissions by **55** % by 2030 by introducing new and revised legislation on energy and climate. This would mainly help mitigate climate change. The revision of **LULUCF**, through reduced emission and increased carbon removal requirements for the land use sector, would in particular yield biodiversity co-benefits such as reduced tillage to enhance soil carbon, or increasing standing biomass in forests. The revision of the **Renewable Energy Directive** and related guidance has the potential of reducing negative impacts on forest ecosystems as a result of stricter requirements for using forest biomass

[103] Proposal for a Regulation on deforestation-free products, COM(2021) 706.

for energy production. Other elements in this package are expected to have less notable effects on biodiversity.

The **Biodiversity Strategy for 2030** also contains other proposed objectives and initiatives that can contribute to the recovery of ecosystems. **BDS2030 pillar 1 on protection** outlines voluntary protection targets. The protection of at least 30% of EU land and sea will help promote passive and active restoration in these protected areas. The commitment *'to ensure no deterioration in conservation trends and status of all protected habitats and species by 2030'* and *'to ensure that at least 30% of species and habitats not currently in favourable status are in that category or show a strong positive trend'* will only be achieved if it goes hand in hand with a significant restoration of the ecosystems in which these habitats and species occur.

BDS2030 pillar 2 on restoration provides some aspirational targets for restoration of **agro-habitats** for which the biodiversity strategy would work in tandem with the **Farm to Fork Strategy.** This sets voluntary commitments to increase organic farming, reduce pesticide and fertiliser use, introduce landscape features, and improve soil health. The **EU Pollinators Initiative** is furthermore currently being reviewed to put in place enabling measures with the aim of reversing the decline of pollinators by 2030.

The latest **Common Agricultural Policy** agreement gives the opportunity to Member States to use funds for environmental purposes. However, all Member States face competing priorities, and the 2014-20 experience of greening measures is that they have made a limited contribution to improving the environmental performance of farming[104]. This combined with past experience with voluntary commitments (as outlined in Section 2.2) makes that significant additional restoration cannot be expected unless Member States are mandated to achieve a certain level of restoration of degraded agro- or forest ecosystems.

For restoring **marine habitats**, the biodiversity strategy sets out the commitment to reduce bycatch and damage to seabeds. To achieve this, the strategy not only relies on the MSFD but also on the Common Fisheries Policy and the Marine Spatial Planning Directive (MSPD). The evaluation of the Biodiversity Strategy to 2020 noted high negative biodiversity impacts and continuing overfishing in certain EU sea basins. In the Mediterranean, for instance, most stocks are still massively overfished while a large number of north-east Atlantic stocks are fished sustainably. As regards the MSPD, several Member States have not adopted their maritime spatial plans by the implementation deadline of the MSPD. While ongoing policy developments, such as strengthening national marine spatial plans, providing guidance on priority areas and improving knowledge, will surely focus minds on ecological objectives in the marine environment, it remains to be seen in how far they will result in actual restoration outcomes.

For **freshwater ecosystems**, the strategy sets the voluntary target to restore 25 000 km of rivers to free-flowing state through barrier removal. To help Member States achieve this,

[104] European Court of Auditors Special Report 22/2017, Special Report 13/2020 and COM(2018)790 final.

the Commission will provide technical guidance to identify sites and mobilise funding. However, broad uptake cannot be guaranteed because of the target's voluntary nature. For **urban ecosystems** the strategy commits to stop the loss of green urban ecosystems, and calls on European cities of at least 20 000 inhabitants to develop ambitious Urban Greening Plans by the end of 2021. Again, the level of uptake and effectiveness cannot be guaranteed.

The strategy aims to halve the number of Red listed species threatened by invasive alien species, which is to be made possible by implementing the **Invasive Alien Species Regulation**. The **Forest Strategy** furthermore announced that definitions, indicators, guidelines, cooperation and a certification scheme will follow, most of which are voluntary. Without a legally binding basis, including provisions for achieving a certain level of forest ecosystem condition, it is questionable that it will lead to significantly more restoration. The **Zero Pollution Action Plan**, **Circular Economy Action Plan, Adaptation Strategy, Soil Strategy** and the proposed **Regulation on deforestation and forest degradation** will furthermore address pollution, over-exploitation of natural resources, climate change, soil health and deforestation.

BDS2030 pillar 3 on enabling transformative change announces several initiatives such as a new governance framework and further commitments to dedicated funding. However, without legally binding obligations it remains to be seen how much uptake this will generate and how much would be focussed on restoration as such. **BDS2020 pillar 4 on the global biodiversity agenda** underlines a commitment to the ambition that 'by 2050, all of the world's ecosystems are restored, resilient, and adequately protected'. If adopted at the next CBD COP 15, which is to adopt a new Global Biodiversity Framework, it will put additional pressure on the EU to fulfill its commitments and lead by example.

The above EU policies will all have positive contributions to restoration but on their own will not be sufficient to lead to tangible verifiable restoration objectives outlined in Chapter 4 and thus leaving significant gaps that the legally binding targets can address.

Estimates of the evolution of the baseline for each main ecosystem type are given in the thematic assessments in Annex VI. Annex VII provides a description of the likely trends of the baseline in broad terms.

5.2. Description of the policy options

This section describes the policy options. These describe four main policy options: the baseline and three options for legally binding restoration targets that aim to address the shortcomings in EU policy. In essence, these consider different ways of setting targets, either aiming at broad overarching restoration targets, or much more specifically defined restoration targets at the level of specific ecosystems, or a form of hybrid target. These are: 2) an overarching legally binding target for ecosystem restoration, 3) legally binding ecosystem-specific targets, and finally 4) legally binding ecosystem-specific targets with an overarching objective. The options are described further described below in 5.2.1, and then 5.2.2. describes how implementation would be ensured for these options.

5.2.1 Options for setting targets

Policy Option 1 – Baseline

The baseline is described in section 5.1. and assumes the implementation of policies in the Green Deal and Biodiversity Strategy for 2030 and other relevant existing polices *with the exception of the legally binding restoration targets*. A more detailed description of the baseline is given in Annex VII.

Policy Option 2 – An overarching legally binding EU target for ecosystem restoration

Considering that the voluntary target set out in the Biodiversity Strategy to 2020 was not achieved, this option considers putting in a place a clearly defined legally binding version of this overarching target to restore ecosystems with deadline dates. Such an overarching target could be defined as: **By 2050, ecosystems in the EU are restored to and maintained in good condition**, complemented by legally binding milestones, that "by 2030, 20%, and by 2040, 60% of ecosystems in the EU are restored to and maintained in good condition"[105]. This EU target would be defined to cover the broad range of ecosystems in the EU, as described and listed in 4.2.

Such an overarching legally binding EU target would be established in legislation, and Member States would be required to reach the target on their own territories. They would be required to set up **national restoration plans** to reach the overarching target. This would give each Member State the freedom to decide how to best achieve their target based on their geographical characteristics and national preferences. The Commission could also provide guidance on which ecosystems to prioritise according the different milestone dates.

Overarching targets for restoration across the EU have also been proposed by the European Parliament and some stakeholders. For example, the Parliament resolution proposes a target to restore at least 30 % of the EU's land and seas, which should be fully implemented by each Member State throughout their territory[106]. The assessment in section 6.2 also applies to a large extent to that proposed target, given that this target is very similar to the one analysed, other than the percentages that are slightly different.

The option would also include the requirement of **no deterioration** of ecosystems, to avoid that restored ecosystems are subsequently destroyed or damaged. See Annex X for a more detailed description of how this could be accomplished.

[105] The proposed targets of 20% and 40% aim for a realistic distribution over time of the effort needed, taking into account that the period between entry into force and 2030 will be short, and that by 2040 a high enough perscentage (60% and not e.g. 40 or 50%) will provide a better overall benefit/cost ratio, as shown in the impact assessment of the specific targets.

[106] European Parliament resolution of 9 June 2021 on the EU Biodiversity Strategy for 2030: Bringing nature back into our lives (2020/2273(INI).

Monitoring and reporting of ecosystems covered by the BHD, WFD or MSFD, could be addressed by the monitoring and reporting mechanisms of that legislation. This would enable Member States and the Commission to measure progress towards a subset of the target. This, however, would only allow for partial coverage of ecosystems that would contribute to the target being reached. For other ecosystems, for which information about condition is not available through existing monitoring and reporting mechanisms (e.g. agro-ecosystems or forest habitats not listed in Annex I of the Habitats Directive), additional methodologies and monitoring mechanisms would have to be developed (so that Member States can determine which of those ecosystems need to be restored. The requirement to develop such an EU wide methodology could also be set in legislation. This could be an EU wide methodology across ecosystems in the EU or be based on the approach as described in option 3.

Policy Option 3 – Legally binding ecosystem-specific targets

The legislation would set legally binding ecosystem-specific targets for a range of ecosystems, habitats, or (groups) of species that should be restored by 2050. Targets would be established for each of the EU's main ecosystem types (i.e. wetlands; forests; agro-ecosystems and grasslands; heathland and scrub; rivers, lakes and alluvial habitats; marine; urban ecosystems; and pollinators as a specific species group) **that would be directly applicable at Member State level**. For soils, a target (rewetting of drained peatland) and an indicator (on soil organic carbon) have been included under agro-ecosystems. The targets and sub-options for the specific targets for each of the main ecosystem types are provided in Annex V. A summary table of the targets selected is provided below.

Member States would set up **national restoration plans** to reach these targets at national level. This would give each Member State the obligation to restore based on their national biographical situation (for example land-locked Member States would obviously not have any marine ecosystems to restore) and they would have ownership of exactly how to plan to reach the targets.

The **evidence base** and methodology for arriving at a set of specific targets is described in Annex IV. This evidence base stems from stakeholder workshops, in-house expertise in the Commission, as well as the EEA. Data and information about Annex I habitats and the related targets comes primarily from reporting by Member States under the Habitats Directive, providing evidence of how much area needs to be restored, that was analysed in detail with the help of the EEA. Other targets such as for farmland birds are underpinned by the farmland bird index or follow from studies, including the EU Ecosystem Assessment, and related work by the JRC, the EEA and the European Topic Centre on Biodiversity.

The option would also include the requirement of **no deterioration** of ecosystems (the approach of how to address this is given in Annex X).

This option would use a **stepwise approach** (Figure 6). In step 1 (the initial adoption of the legislation), targets would be set for ecosystems, habitats or groups of species for which data, baselines and monitoring mechanisms are available. This would result in targets being set for each of the main ecosystem types in step 1 (see table below and Annex V). For terrestrial ecosystems, targets to restore Annex I habitats of the Habitats Directive would cover 24%[107] (949 990 km^2) of the EU's land area, corresponding to areas both within Natura 2000 and outside of Natura 2000. Of the terrestrial Annex I area, 182 985 to 536 669 km^2 would need to be restored (see table 1, section 2.1.2). Other species targets such as on protected species, farmland birds or pollinators would indirectly address a bigger part of the EU land area. Using a stepwise approach was proposed and supported at the stakeholder workshops.

For ecosystems, habitats or species for which data and monitoring mechanisms are not yet present or not yet sufficiently developed-, such as agro-ecosystems and forest habitats not listed in Annex I of the Habitats Directive, Member States would be required to achieve a positive trend of certain key biodiversity indicators. Meanwhile a process would be established in the legislation to develop an **EU-wide methodology** for assessing their condition. The methodology is described further below as an enabling measure, and would be developed by the Member States and the Commission. This would lay the basis for setting baselines and thresholds of good condition for further restoration targets to be established in step 2. Based on this, **impact assessments** of these targets would be carried out. The targets then established in step 2 would then gradually increase coverage and in principle cover all of the EU's area. Step 2 targets would be established by revising the legislation adopted in step 1 (see Figure 6). Developing an EU-wide methodology was proposed and supported at the stakeholder workshops.

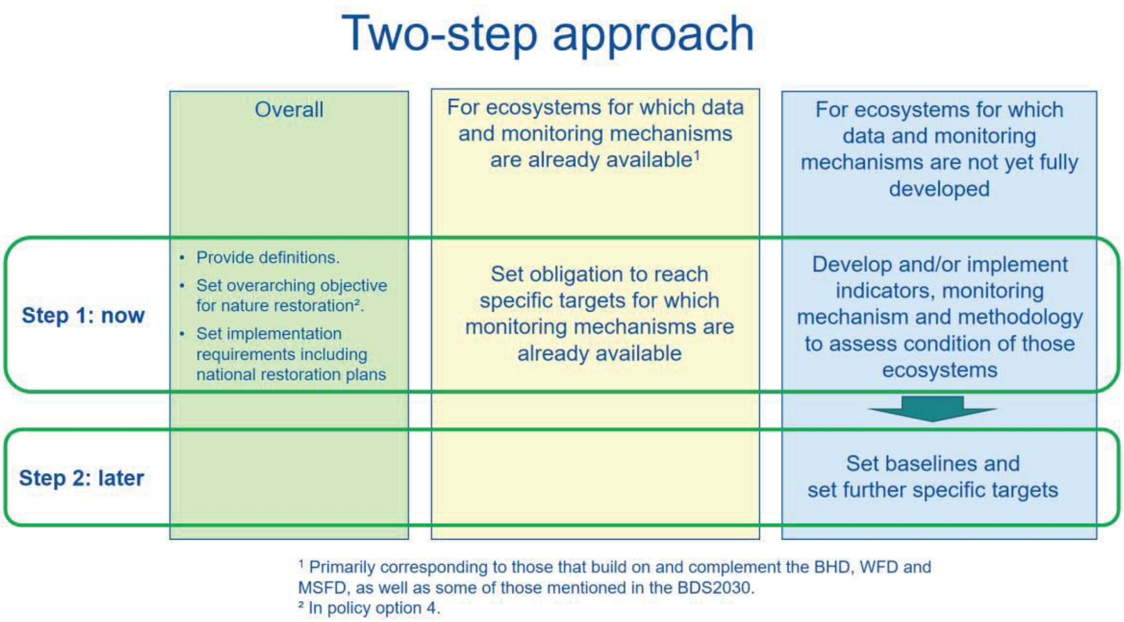

Figure 7: Two-step approach for ecosystem-specific targets (policy option 3), in combination with an overarching objective (policy option 4).

[107] Romania is not included due to data issues.

SELECTED TARGETS AND OBLIGATIONS FOR STEP 1

WETLANDS (incl. Peatlands, marshlands & coastal wetlands)

- Restore all HD Annex I wetland habitat area to good condition, with all necessary restoration measures completed on 30 % (or 15 %)[108] of degraded areas by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
- Recreate 30 % (or 15 %) of additional habitat area required to achieve favorable conservation status of HD Annex I wetland habitats by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
- Restore and re-create the area as necessary to enhance the conservation status of species listed in Annex II, IV and V of the Habitats Directive as well as wild birds associated with wetlands in view of achieving their favourable conservation status by 2050, with at least 30 % achieved by 2030 and at least 60 % by 2040.

FORESTS

- Restore all HD Annex I forest habitat area to good condition, with all necessary restoration measures completed on 30 % (or 15 %) of degraded areas by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
- Recreate 30 % (or 15 %) of additional habitat area required to achieve favorable conservation status of HD Annex I forest habitats by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
- Restore and re-create the area as necessary to enhance the conservation status of species listed in Annex II, IV and V of the Habitats Directive as well as wild birds associated with forests in view of achieving their favourable conservation status by 2050, with at least 30 % achieved by 2030 and at least 60 % by 2040.
- Achieve a continuously improving trend of each of the following indicators, until satisfactory levels are achieved or until new targets are in place: deadwood, age structure, forest connectivity, tree cover density, abundance of common forest birds, soil organic carbon in forest land.

AGRO-ECOSYSTEMS AND GRASSLANDS

- Restore all HD Annex I agricultural habitat area to good condition, with all necessary restoration measures completed on 30 % (or 15 %) of degraded areas by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
- Recreate 30 % (or 15 %) of additional habitat area required to achieve favorable conservation status of HD Annex I agricultural habitats by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
- To increase the populations of farmland birds as measured by the common farmland bird index re-set at 100 at year X [one year after the entry into force of this Regulation] to:
    i. 110 by 2030, 120 by 2040 and 130 by 2050, for Member States with historically depleted populations of farmland birds;
    ii. 105 by 2030, 110 by 2040 and 115 by 2050, for Member States that do not have historically depleted populations of farmland birds.
- Restore and re-create the area as necessary to enhance the conservation status of species listed in Annex II, IV and V of the Habitats Directive as well as wild birds associated with agro-habitats and grassland in view of achieving their favourable conservation status by 2050, with at least 15 %/30 % of all necessary actions carried out by 2030 and 40 %/60 % by 2040 and 100 % 2050.
- For drained peatlands under agricultural use, to put in place restoration measures, including rewetting, on at least:
    i. 30% of such areas by 2030 of which at least a quarter is rewetted;
    ii. 50% of such areas by 2040 of which at least half is rewetted, and
    iii. 70% of such areas by 2050 of which at least half is rewetted.
- Achieve a continuously improving trend of each of the following indicators:
    i. grassland butterfly index;
    ii. organic carbon content in cropland mineral soils;

  until satisfactory levels are achieved or until the new targets are in place; and

[108] The percentages between brackets represent an alternative (slower) rate of restoration. See explanation in section 6.3.

iii. share of agricultural land with high-diversity landscape features until 2030, with the view to achieving the EU commitment to bring back at least 10% of agricultural area under high-diversity landscape features by 2030; iv. percentage of species and habitats of Union interest related to agriculture with stable or increasing trends until 100% is reached at the latest by 2050.
HEATHLANDS & SCRUB, ROCKY & DUNE HABITATS (SPARSE VEGETATION)
- Restore all HD Annex I steppe, heath and scrub, rocky & dune habitat area to good condition, with all necessary restoration measures completed on 30 % (or 15 %) of degraded areas by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050. - Recreate 30 % (or 15 %) of additional habitat area required to achieve favorable conservation status of HD Annex I steppe, heath and scrub, rocky & dune habitats by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050. - Restore and re-create the area as necessary to enhance the conservation status of species listed in Annex II, IV and V of the Habitats Directive as well as wild birds and associated with steppe, heath and scrub, rocky & dune habitats in view of achieving their favourable conservation status by 2050, with at least 30 % (or 15 %) of all necessary actions carried out by 2030 and 60 % (or 40 %) by 2040 and 100 % by 2050.
FRESHWATER: RIVERS, LAKES AND ALLUVIAL HABITATS
- Restore all HD Annex I rivers, lakes and alluvial habitat area to good condition, with all necessary restoration measures completed on 30 % (or 15 %) of degraded areas by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050. - Recreate 30 % (or 15 %) of additional habitat area required to achieve favourable conservation status of HD Annex I rivers, lakes and alluvial habitats by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050. - Restore and re-create the area as necessary to enhance the conservation status of species listed in Annex II, IV and V of the Habitats Directive as well as wild birds associated with rivers, lakes and alluvial habitats in view of achieving their favourable conservation status by 2050, with at least 15 % achieved by 2030 and at least 40 % by 2040. - Develop an inventory of barriers to longitudinal and lateral connectivity of rivers and a detailed plan of which barriers will be removed, with a view to achieving free-flowing status where possible and necessary to restore the habitats depending on such connectivity. - Mapping out of small water units, with a view to identify their restoration and recreation potential and assess their contribution to improve connectivity between habitats as part of high diversity landscape features, contributing to the restoration of habitats and species.
MARINE ECOSYSTEMS
- To put in place the necessary restoration measures to improve all areas that are not in good condition to good condition in specified marine habitat types, with measures put in place on at least 30 % of such areas by 2030, on at least 60 % of such areas by 2040, and on at least 90 % of such areas by 2050[109]: a. HD Annex I marine habitats (sub-types of Annex I habitat types, such as seagrass beds, macro-algal forests, sponge, coral and coralligenous beds, maerl beds, shellfish beds, vents and seeps); b. Marine habitats outside HD Annex I (such as marine shelf sediments). - To put in place the restoration measures necessary to re-establish those habitat types in areas not covered by those habitat types, on at least 30 % of the additional area needed to reach the favourable reference area of each group of habitat types by 2030, at least 60 % of such areas by 2040, and 100 % of such areas by 2050; - To put in place restoration measures for the habitats of marine species listed in Annexes II, IV and V of the HD and Annex I to Regulation 2019/1241 and of wild birds covered under Birds Directive, that are needed to improve the quality of those habitats, re-establish those habitats and create

[109] It is important to bear in mind the long time periods to restore certain marine ecosystems, thus this proposed target is based on putting necessary measures into place by 2030 and with the aim of arriving at good condition beyond 2030.

sufficient connectivity among those habitats corresponding to the ecological requirements of those species.
URBAN ECOSYSTEMS
• To ensure that there is no net loss of urban green space, and urban tree canopy cover by 2030, compared to 2021, within all cities and towns and suburbs; • To ensure that there is an increase in the total national area of urban green space in cities and towns and suburbs of at least 3 % of the total area of cities and towns and suburbs in 2021, by 2040, and at least 5 % by 2050. In addition Member States shall ensure: i. a minimum of 10 % urban tree canopy cover in all cities and towns and suburbs by 2050; and ii. a net gain of urban green space that is integrated into existing and new buildings and infrastructure developments, including through renovations and renewals, in all cities and towns and suburbs.
POLLINATORS
- Reverse the decline of pollinators[110]: This target relates in particular to the following ecosystems: agro-habitats and grasslands, wetlands, forests and heathlands & scrub.
An EU wide methodology for assessing the condition of ecosystems would be established in Step1.

To illustrate the **areas of ecosystems that would be covered by the targets in the EU**, the **example of forests** is provided. For Step 1 the first forest target to restore Annex I forest area would cover 28% of EU terrestrial forest area, which is the percentage of the overall EU forest area covered by Annex I habitats (based on best available data). The second target on recreation could pertain to potentially any terrestrial area, since recreation could be carried out in principle anywhere inside or outside Annex I habitats. Likewise, the third target on ensuring the conservation status of species could pertain to potentially any terrestrial area, since the species could occur in any area inside or outside of Annex I habitats. For step 2, a more specific target on restoring non-Annex I habitats forest area would have to be defined. However, in principle it could apply to up to 72% of the EU terrestrial forest area (i.e. any non-Annex I area).

As regards **potential targets for step 2,** a table of initial potential targets is provided below. They have been identified as potential future targets in the ecosystem specific impact assessments (see Annex VI). For these, further methodological development and analysis would be needed.

POTENTIAL TARGETS FOR STEP 2 THIS INCLUDES AN INITIAL LIST AND FURTHER TARGETS MAY BE DEVELOPED
WETLANDS (incl. Peatlands, marshlands & coastal wetlands)
FORESTS
• Restore degraded non-HD Annex I forest habitat areas.
AGRO-ECOSYSTEMS AND GRASSLANDS
• Restore and recreate semi-modified and semi-natural grasslands. • Restore and recreate unploughed / untilled grasslands.

[110] For pollinators, it is likely that finalising the measurement methodology and establishing a baseline would be ready by 2023. Given that negotiations with Parliament and Council on the proposal would last until at least mid-2023, this target could already be included in the legislative proposal.

HEATHLANDS & SCRUB
FRESHWATER: RIVERS, LAKES AND ALLUVIAL HABITATS
• Numerical target on the restoration of free flowing rivers[111] • Restoration of small water units**.**
MARINE ECOSYSTEMS
• Target on specific marine animal species
URBAN ECOSYSTEMS
SOILS
• Target on contaminated soils.
POLLINATORS

Box 5: Views of stakeholders and authorities on ecosystem-specific targets to prioritise.

In terms of ecosystems to be restored, the responses submitted in the Open Public Consultation via the #RestoreNature campaign strongly prioritised wetlands, freshwater and marine ecosystems, forests, heathlands and shrublands. Respondents who were not part of this campaign tended to consider most ecosystems to be of moderate to high priority for restoration, with a stronger emphasis on freshwater and wetland ecosystems. They also showed significantly stronger support for the restoration of modified ecosystems such as agroecosystems, urban and soil ecosystems. Open-text comments added as priority the urban-rural interface and issues facing agricultural ecosystems such as intensification, urban sprawl and climate change (academic organisations' contributions), as well as ecosystems with high carbon storage and sequestration potential, such as peatlands, coastal and inland wetlands, floodplains, old-growth forests, high-biodiversity grasslands and marine ecosystems (NGOs). Some organisations drew attention to specific species in need of restoration.

In the course of the consultation workshops, conservation, academic and protected area management organisations as well as national authorities repeatedly emphasized the importance of ecological connectivity, the needs of migratory species and targets for vulnerable species that are more difficult to restore. National authorities expressed diverging opinions, from prioritising ecosystems with the most unfavourable status to those with the most human health benefits. Some also referred to cost-effectiveness,

[111] This is related to the target in step 1 which requires Member States to develop inventories of barriers to longitudinal and lateral connectivity of rivers and a detailed plan of which barriers will be removed, with a view to achieving free-flowing status where possible and necessary to restore the habitats depending on such connectivity. This will contribute to achieving the voluntary target of the BDS2030 of 25 000 km of free flowing rivers. As part of step 2, a more exact approach to setting a numerical target on free-flowing rivers, including lateral and longitudinal aspects, would be developed.

given limited resources, and to the need for a common prioritisation framework. Views of nature NGOs included the need to prioritise benefits to biodiversity over benefits to climate, and the importance of ecosystem services that are not easily quantified or monetised. Research institutes also referred to the importance of prioritising and communicating about restoration benefits to people.

Environmental NGOs expressed broad support for targets on agro-ecosystems, considering that they comprise 39% of EU land and are of importance for biodiversity. Different organisations supported targets on wetlands, urban ecosystems (especially on abandoned land), rivers (particularly on free-flowing rivers, keystone species such as eel) and pollinators, as well as the importance of passive restoration for marine ecosystems. An organic farming association underlined that ecosystem restoration and food production are no contradiction, considering the reliance on biodiversity and welcomed targets and indicators on pollinators, farmland birds and soil health. A small-scale farming association warned that intensive farmers would be paid to restore degraded agro-habitats due to intensive farming. A forestry association underlined the importance of reaching favourable status of forests also in light of climate benefits. Some research stakeholders welcomed urban restoration as a means to bring benefits close to the people. Some conservation organisations considered the target to complete all necessary marine restoration measures by 2050 unrealistic considering maritime activities and climate change. A potential risk was identified by experts in environmental organisations and authorities in relation to a target to increase Soil Organic Carbon, which could be detrimental if applied to vulnerable habitats with naturally poor soils (such as dunes).

As concerns the proposed 2-step approach, national authorities expressed broad support to ensure positive results in step 1 for a number of ecosystem types. Environmental NGOs underlined the need for quick action but also inquired about mechanisms for the second stage. Research institutes emphasized that scientific knowledge is available to support the restoration of priority ecosystems. Several Member States authorities envisaged difficulties in implementing restoration beyond Natura 2000. At the same time, several Member States asked for more ambition to ensure ecological connectivity and for extending the focus beyond natural habitats (Annex I), to cover green infrastructure and to diversify agricultural landscapes. One Member State suggested a separate target on high-diversity landscape features. It was suggested that targets should be considered for intermediary steps towards more naturalness, e.g. to move away from monocultural forests and towards more natural rivers, and that restoration provisions do not lower the ambition of existing requirements.

How views of stakeholders and authorities have been taken into account:

The proposal includes targets for practically all ecosystems highlighted by stakeholders, including, for instance, pollinators, rivers, urban green areas and agro-ecosystems, in line with the objective of the Biodiversity Strategy for 2030 to restore all EU ecosystems. Also the aspect of connectivity has been taken on board as an essential aspect of ecosystem restoration, as it is an integral part of the definition of 'restoration measure' and explicitly mentioned in some of the targets. On the marine targets and on soil

organic carbon, discussions are stepped up with relevant experts to ensure that targets defined in the law are implementable, do not duplicate what exists and cause no adverse effects.
The proposal also responds to the stakeholder views that action is urgently needed, and that ecosystem restoration should go beyond the Annex I habitats. Therefore, the proposal includes the two-step approach suggested by stakeholders, i.e. setting targets now where the knowledge and monitoring systems are available, going already beyond Annex I habitats, and setting up a method and process for setting additional targets later.

Policy Option 4: Legally binding ecosystem-specific targets with an overarching objective

This is a hybrid of the specific targets of option 3 and a variant of option 2, namely an overarching objective '**to contribute to the continuous, long term and sustained recovery of biodiverse and resilient nature across EU land and sea areas through the restoration of ecosystems and to contribute to the EU's overarching objectives concerning climate change mitigation and adaptation, and to contribute to meeting the EU's international commitments; and that the restoration measures together shall cover, by 2030, at least 20 % of the Union's land and sea areas and, by 2050, all ecosystems in need of restoration'.** This overarching objective provides a clear political aspiration that the EU should strive towards, as well as an area objective that the EU shall stive towards (a variation of option 2). The objective is underpinned by a set of ecosystem-specific legally binding and enforceable targets and obligations for Member States (option 3). It should be underlined that the overarching objective would be applicable at EU level, but not directly enforceable as such. What will be enforceable are the set of specific targets taken from option 3, and for which enforceability is described in section 5.5.2 below.

While the overarching objective drives the long-term direction and supports communication, political and mainstreaming purposes, the set of binding ecosystem-specific targets define in more concrete and measurable terms what needs to be achieved by when by the Member States. Having an overarching objective in addition to the specific targets can aid the achievement of the objectives. This was seconded by **stakeholders** during consultations.

The **overarching objective functions in a similar way as the climate-neutrality objective in the European Climate Law**[112], expressing the common ambition across Member States and stakeholders, bringing the different target options under one umbrella and driving overall direction to 2050. It also provides a clear link to the EU's commitment to achieve both the headline ambition of the Biodiversity Strategy for 2030, which extends to 2050, as well as the global vision under the Convention on Biological Diversity. The overarching objective provides a unified framework for action beyond 2030 and makes it

[112] COM/2020/80 final.

clear that the legislation intends to go beyond only restoring those ecosystems for which targets are set in step 1. The fact that it includes maintenance of ecosystems, further highlights that restoration needs to go hand in hand with protection.

It can be estimated that the **overarching objective** would correspond to Member States putting into place restoration measures which together would **cover at least 20% of the Union's land and sea areas by 2030.** The section below provides an estimate of the total EU areas that restoration measures will cover by 2030. In the longer term, **all ecosystems in need of restoration should have restoration measures put in place by 2050.**

In order to estimate the areas that would be covered with restoration measures by 2030 to reach the targets and obligations of the proposal, one can break down the calculations as follows: the Annex I terrestrial habitat targets, other terrestrial targets and obligations, and the marine targets. It should be understood that these are only approximate, order of magnitude, estimations.

A summary of the estimates is as follows:

The **terrestrial estimate** is based on targets related to the habitats of Annex I of the Habitats Directive, as well as other targets and obligations such as on forests, agroecosystems and urban. The estimates of restoration measures as given as percentages of EU land area:

Annex I terrestrial habitats:	1.3%-3.8%
Agro ecosystems :	6%
Forest Ecosystems:	4.3%-9.0%
Urban:	0.07%

We can assume that the other obligations (e.g. on pollinators, farmland birds, habitats of protected species forest and agricultural ecosystem indicators) will require action on more areas than the ones mentioned above thus increasing the above and compensating the possible overlaps with Annex I habitats, although it is difficult to make exact estimates of these. We can therefore safely underpin the number of **at least 20% of EU land area** with restoration measures by 2030.

For the **Marine area,** the estimates are based on areas of the marine habitats proposed for restoration. This includes soft sediment and other habitats, such as sub-types of marine habitats listed in Annex I HD. An additional estimate is based on the marine areas to be restored for the habitats of marine species. The estimates of area to be covered by restoration measures are given as percentages of EU-27 European marine waters (with Macaronesia).

EU seabed area to be restored:	≈10%
Areas to be restored for species :	≈10%

We estimate that around **20% of EU marine area** will have restoration measures by 2030 in order to achieve the target. This also corresponds and build on with the target of the EU

Biodiversity Strategy for 2030 to strictly protect at least 10% of the marine area (strict protection is a passive restoration measure) and to protect at least 30% of marine land (part of the 20% protected areas not strictly protected will also require restoration by 2030).

Therefore, we can reasonably say that **by 2030, at least 20% of EU land and sea area** will have restoration measures.

As for option 3, a **two-step approach** is proposed for the **ecosystem-specific targets** in option 4.

It is important to point out that the three options above give consideration of how **restoration should work hand in hand with effective protection and maintenance**. This is because it is also important to ensure that the condition of ecosystems is not allowed to deteriorate before or after restoration, to avoid perverse effects. This is why the requirement of **non-deterioration** is included in the options. This can apply to areas that need to be restored as well as those that are already in good condition and need to be maintained. Restored areas need to receive a degree of protection that will ensure their full recovery and the long-term viability of the restored ecosystem. These could for example be designated as protected areas and be taken into account for the 30 % protected area and 10 % strictly protected area targets of the EU Biodiversity Strategy for 2030. A further analysis of this approach to non-deterioration is provided in Annex X, part 3, for the three main EU territory regimes.

Box 6: Views of stakeholders and authorities on the choice of overarching and ecosystem-specific targets

*When all responses to the **open public consultation** were considered, there was close to full support both for an overarching restoration goal (97%) and for specific targets for ecosystems (96%). When the responses submitted via the #RestoreNature campaign were isolated, stakeholders active in the forestry sector in Poland formed the majority of the remaining respondents. These stakeholders indicated relatively low support for an EU-level target across all ecosystems (40%) and even lower support for ecosystem-specific EU restoration targets, while open responses indicated preference for the setting of targets at the national level.*

*In the **consultation workshops** held by the Commission with Member State experts and EU-level stakeholders, there was **broad support for specific targets in addition to an overarching objective**, with enabling measures and complementarity to existing legislation. Environmental NGOs and research institutes expressed particularly broad support for EU legally binding ecosystem-specific targets, high restoration ambition and a combination of process- and outcome-oriented targets that focus on Habitats Directive Annex I habitats but also go further to cover all EU ecosystems. An overarching restoration target of 15% of degraded ecosystems for 2030 was seen as too low, with NGOs suggesting a target to restore 15% of the EU land and EU sea area. Most national* *authorities supported an overarching aspirational goal set at EU level coupled with ecosystem-specific targets set at the national level, so that they can decide what ecosystems to restore. Some national authorities considered that enhanced restoration requirements could be set within existing legislation. Associations of stakeholders (agriculture, forestry and forest owners) indicated preference for soft measures over legally binding instruments, underlined the need to respect ownership rights and promoted a voluntary bottom-up approach. Forest stakeholders expressed preference for process targets over outcome targets.*

States authorities and stakeholders alike pointed to the need to ensure that the targets work in synergy among themselves and with existing EU legislation and policies. Forestry sector representatives questioned whether targets could be set without knowing the location and the concrete measures, which would allow an assessment of their feasibility. Environmental organisations called for an emphasis on the 2030-2040 period in terms of contributing to the biodiversity and climate targets rather than to 'back-load' the ambition. They also emphasized that all targets should consider the ***impact of climate change*** *and with this the evolution of ecosystems and invasive alien species. Most stakeholders and national authorities welcomed a 2-step approach and clear milestones. Some research institutions, environmental NGOs and national authorities expressed support for targets going beyond HD Annex I habitats, already in step 1.*

How the views of stakeholders and authorities were taken into account:

See previous boxes on the views on overarching and specific targets, binding versus voluntary/aspirational measures, synergies with existing legislation, going beyond Annex I habitats and a 2-step approach. Regarding the ambition level, the preferred option includes the scenario to restore 30% by 2030 and 60% by 2040 for a number of targets, which can be considered ambitious considering that currently, the condition of many ecosystems is still degrading. The impact of climate change is considered, for instance by building in the requirement for increased connectivity, which facilitates migration of species.

5.2.2. Implementation framework and enabling measures

Several enabling measures are essential to ensure delivery and to contribute to an **effective framework of implementation**. All the aspects of the implementation framework will be instrumental in ensuring ownership, engagement, implementation and enforcement. The main components are described below. Components A, B, C and D are included in options 2, 3 and 4. Component E is only included in options 3 and 4.

A. National Restoration Plans (NRPs)

Member States would have to determine how to achieve the targets and would be required to prepare and adopt plans for restoration and other enabling measures, in National Restoration Plans (NRPs). The NRPs will be instrumental in planning and prioritising activities, as well as in channelling and optimising financial and other resources from EU and Member States' sources. Relevant Member States would also have to pay specific attention to the restoration of their outermost regions' ecosystems within their plans. The development of the NRPs will be instrumental in ensuring the engagement and ownership of Member States in carrying out restoration activities necessary for reaching the targets. For ecosystems spanning across borders, Member States could foster synergies with the national restoration plans of other Member States.

These NRPs would include the following components:

- A **quantification of the areas** to be restored to reach the restoration targets based on preparatory monitoring and research that takes into account the latest scientific evidence, in particular on: 1) for each of the habitat types: a) the total habitat area; b) a clear identification of the areas that are not in good condition; c) the area needed to reach favourable conservation status (favourable reference area) and d) the areas most suitable for re-establishment, taking into account projected changes to environmental condition due to climate change; 2) for habitats of protected species covered by the Birds and Habitats Directives: a) a quantification of the areas needed for the achievement of favourable conservation status of these species, as well as b) the quality needed for these habitats that corresponds to the ecological characteristics of these species. The plans will also include measures based on preparatory work on: 1) for agricultural ecosystems: a) the identification of the agricultural areas in need of restoration, in particular the areas that, due to intensification or other management factors, are in need of enhanced connectivity, landscape diversity; b) the satisfactory levels for key biodiversity indicators such as the grassland butterflies index, the stock of organic carbon in soils, the share of agricultural land with high-diversity landscape features; c) the areas of drained peatland under agricultural use to be restored and rewetted; 2) for forest ecosystems: the satisfactory levels for key biodiversity indicators such as deadwood, age structure, forest connectivity, tree cover density, abundance of common forest birds and stock of organic carbon in soils. Finally, the plans will include the inventory of barriers to longitudinal and lateral connectivity of surface waters.
- Plans for **specific restoration measures**, also clarifying where to prioritise restoration (e.g. making links with protected areas, identifying areas with strongest benefits for carbon capture and storage, taking into account the predicted effects of climate change on ecosystems, etc.).
- A concrete **financing plan**, that includes EU funding sources, national sources, and public/private financing . The plan should also describe where and how to best deploy this financing. Financing would mainly be used to support restoration activities but would also include providing assistance, or developing alternative incomes based on the provision of ecosystem services, to those

potentially affected by the restoration. The financing possibilities at EU level that the NRPs would channel are illustrated in Annex XII.

- How to effectively **monitor on progress** towards the targets, i.e. the monitoring that would be put in place on the areas subject to restoration measures to assess their effectiveness.In order to seek synergies for biodiversity and climate change adaptation/mitigation, and to carfully consider potential trade-offs, Member States should include a dedicated section setting out how the national restoration plan considers (i) the relevance of climate change scenarios for the planning of the type and location of restoration measures; (ii) the potential of restoration measures to minimise climate change impacts on nature and to support adaptation; (iii) synergies with national adaptation strategies and/or plans.
- **Public participation**: How stakeholders would be given opportunities to participate in the preparation of NRPs and various restoration activities. For example, how to address the potential needs of stakeholders that may require support (e.g. farmers, foresters, fishers and landowners) andtransitioning to new practices, in networking and sharing of best practices, in developing new business models that build on the benefits of improved ecosystem services.

Member States will need to periodically report on their progress in terms of **(i) restoration measures undertaken and (ii) description of ecosystem condition.** For targets to be proposed under step 1 based on habitat types listed under the Habitats Directive, monitoring and reporting requirements already exist (they would need to be slightly adjusted). This is because the "condition" of these habitats is described by the "structure and functions" parameter of the conservation status assessment corresponds. The same for protected species under the Habitats and Birds Directives (information on quality and quantity of their habitats is already reported under the nature directives and only slight adjustments would be needed). Further monitoring and reporting requirements for targets to be established in step 2, would be determined as part of the development of the EU-wide methodology (see below), and these further requirements would aim to not introduce unnecessary additional burdens. Reporting by Member States would be required by separate provisions in the proposed restoration law, linking, for instance, with the reporting obligations in the Nature Directives or with the EU-wide methodology, as appropriate.

B. Periodic Review

National restoration plans would need to be submitted to the European Commission and the proposed Nature Restoration Law would establish a process for the **Commission to assess the plans and to address observations to the Member States,** and for the Member States to provide to the Commission all necessary additional information and, where appropriate, revise their proposed plan before adopting it. **The Member States would be required to review the plans after 10 years or sooner and, when necessary, revise the plans.**

A similar approach has been used in other pieces of EU legislation. For example under the *Regulation on the governance of the energy union and the climate action (EU/2018/1999)*, Member States have to establish **National Energy and Climate Plans** (NECPs). As a first step, Member States have to send their draft plans to the Commission, then revise them following the Commission's assessment and then send their final plans back to the Commission'.[113]

The Commission would also review implementation on a periodic basis. Reporting by Member States would be required. The responsibility of the Commission would be to review progress, as reported by the Member States on **(i) restoration measures put into place and (ii) achieving the targets and, where relevant, being on the path to good ecosystem condition.**

The development of the NRPs, feedback given on them and all aspects of the review of implementation will be instrumental in ensuring ownership, engagement, enforcement, and implementation by the Member States. Given the time to prepare plans, carrying out restoration activities and reporting on progress, it is expected that submission of the NRPs, their adoption and the periodic review of implementation would take place in cycles of several years. Ultimately, success would be achieved when all the ecosystem targets are achieved, and for some ecosystems this would require a long time. However, progress would be measured in terms of effective NRPs being developed by Member States, restoration measures being implemented and results achieved in terms of reaching the targets and/or recovery of ecosystems, such as evidence of positive trends in condition or the achievement of good condition.

C. Guidelines and further specifications

Effective implementation may also require mandating in the restoration law the future development of **implementing acts, delegated acts and/or guidelines** for further **specifications** on what **restoration or ecosystem management practices and measures** are needed or what practices could be detrimental towards achieving the targets.

D. EU-wide methodology

The Commission will develop an EU-wide methodology to be used to assess the condition of ecosystems for which information is not currently sufficiently available, and/or no agreed definition of 'good condition' exists, such as agro-ecosystems and forests not covered by Annex I of the Habitats Directive. It would determine the methods for setting indicators, baselines and thresholds for further restoration targets that would be established in step 2. The methodology would build on the data and methods for ecosystems covered by the BHD, WFD and MSFD, the **work of MAES**, that has categorised potential indicators[114] for different ecosystem types, the upcoming proposal for a revision of the

[113] See: https://ec.europa.eu/energy/topics/energy-strategy/national-energy-climate-plans_en.
[114] See the 5th MAES report. For each ecosystem type a table of potential indicators is developed, see for example forests pages 36-37.

Regulation on Environmental and Economic Accounts[115] and standards such as the UN System of Environmental Economic Accounting (UNSEEA)[116] and the Society for Ecological Restoration (SER)[117]. Further guidance would be provided by the Commission, developed with the support of a Committee and/or Expert Group. The preparatory work is already ongoing for a number of potential targets and applicable methods are expected to be available within the first few years after the final adoption of the legislative act at the latest.

Establishing this methodology will be essential to provide the necessary **legal clarity** to establish legally binding targets in step 2 and to monitor progress towards them, as it will provide clear definitions and thresholds of what constitutes good condition for relevant ecosystems. It will thus enable Member States to monitor and report on those ecosystems and to assess their condition – information which is needed to set and implement future restoration targets.

E. Cross linkages with LULUCF

During the development of this impact assessment on ecosystem restoration targets, synergies with the proposed revision of the Regulation on land use, land-use change and forestry (LULUCF) have been ensured. This is an important link because restoring ecosystems, in particular coastal wetlands, peatlands, soils and forests will make significant contributions to the proposed fit for 55 package initiatives, in particular with regard to reaching the LULUCF objectives. The main cross-linkage that was developed was on monitoring and reporting, in particular a more integrated system to ensure that **measures on climate mitigation and nature restoration would now be mutually reinforcing and would not undermine each other**. As a consequence, the proposed revised LULUCF Regulation includes provisions for amending the monitoring systems to capture land-use changes according to different land categorisations: (a) high-carbon stock land; (b) land-use units subject to protection; (c) land-use units subject to restoration; (d) land-use units with high climate risk. The proposed amendments to Annex V to Regulation (EU) 2018(1999) concerning methodologies for monitoring and reporting in the LULUCF sector include a formulation that should allow adapting to new EU nature restoration provisions, in particular a reference to areas identified as in need of restoration according to a nature restoration plan applicable in a Member State. The proposed LULUCF revision should thus, amongst other things, enable future patterns of land-use change driven by climate change or climate action to be tracked in terms of the effects on land subject to nature restoration. This is expected to contribute to better and more effective implementation of both the proposed climate regulation and the legally binding restoration

[115] Have your say: Environmental economic accounts - new modules: Proposal for a Regulation of the European Parliament and of the Council amending Regulation (EU) No 691/2011 on European environmental economic accounts.
[116] https://seea.un.org/ecosystem-accounting
[117] https://www.ser.org/

targets being assessed herein. The proposed revision to Annex V to Regulation (EU) 2018/1999 can be found in Annex III of the LULUCF proposal[118].

Box 7: Views of stakeholders and authorities on the enabling measures for implementation.

*As regards the **choice of instruments** to encourage restoration, the overwhelming majority of responses to the **Open Public Consultation** came from the #RestoreNature campaign, giving the highest importance to **national nature restoration plans** and a **progress monitoring and reporting mechanism**, and some importance to awareness raising and ecosystem mapping and assessment. The remaining respondents (from a range of backgrounds including citizens, business, academia and local government, with a significant majority indicating association with the forestry sector) gave the highest importance to awareness raising and the break-down of restoration targets to national contributions.*

*Campaign responses prioritised all suggested **measures to ensure the maintenance of restored ecosystems** (long-term monitoring and reporting, protection designation and, to a lesser extent, anticipation of climate change effects in the planning of restoration actions), while the majority of other respondents prioritised climate change anticipation. Open text responses further referred to sustainable management practices and economic considerations.*

*At the **consultation workshops,** considerable support across all stakeholder groups was voiced for the creation of national restoration plans (NRPs), and the importance of financing was stressed. Environmental NGOs underlined the need for clear content requirements in the NRPs, and for a robust review process. National authorities also expressed some support for NRPs, while underlining their importance for ensuring finance, e.g. at EU level. There were numerous calls for clarity on the **financing**. One Member State warned not to count on private finance too much considering experience from the past.*

***Monitoring:** there was broad support among stakeholder for improved coverage, coherence and comparability in terms of **monitoring methods and data**. National authorities underlined the need to streamline monitoring with existing systems in the scope of existing EU legislation and policies. Suggestions were made to streamline monitoring with the Prioritised Action Frameworks, and to build on the Mapping and Assessment of Ecosystems and their Services (MAES). One Member State expressed concern about the feasibility of mapping the area to be restored in the National Restoration Plan, before having carried out extensive discussions with stakeholders, as this would provoke a lot of reaction. A nature NGO pointed out the need for a common approach (indicators, methodology) if the legislation goes beyond Annex I of the Habitats Directive. A forestry association underlined the need for improved monitoring of ecosystem condition (data and methods) and reporting under existing systems.*

[118] revision-regulation-ghg-land-use-forestry_with-annex_en.pdf

Research stakeholders offered support and underlined need to zoom into regional rather than national level.

*The need to **involve stakeholders** such as farmers and private land owners, as well as the challenges in this regard were stressed by most Member States during the consultations as well as by NGOs and stakeholder representatives themselves. Private forest owners called for an open approach when planning restoration measures in order to build trust and support.*

*Conflicting policy priorities and pressure from other sectors were also highlighted. This raised also the question of **funding** for compensation, restoration, management and other related measures. Several stakeholders pointed to the need to be clear on **who would be responsible to implement** the targets and obligations. Two NGOs commented that the burden of implementation should be placed not only on the nature authorities, but also on other relevant administrations (e.g. water).*

Several workshop participants from the non-governmental sector pointed to the need to diversify the economic sector to engage with the restoration agenda. For example, the national restoration plans could include new economic activities that would provide alternative livelihoods.

How views of stakeholders and authorities have been taken into account:

The proposal includes National Restoration Plans as part of the enabling measures, including a review by the Commission.. Content requirements are already proposed to some extent and will further detailed through the development of a template/format. The concern expressed about the feasibility of mapping the area to be restored in the National Restoration Plan has led to a more carefull formulation of the requirements. Furthermore, the proposal acknowledges the need to involve stakeholders in setting up the National Restoration Plans.

Progress monitoring and reporting have also been included among the obligations for Member States to enable the Commission to follow-up implementation. It is foreseen to create maximal synergies with existing monitoring and reporting obligations, for instance for the BHD and LULUCF.

To ensure the maintenance of restored ecosystem, the non-deterioration obligation has been included in the proposal. Climate change anticipation is included in several ways, for instance by including the ecosystems that have the greatest capacity to contribute to climate change mitigatin and adaption, and by including connectivity in the concept of restoration.

The aspect of financing is also addressed in the enabling measures.

Overview of the components of each policy option

	Binding overarching target	Overarching objective	Binding ecosystem-specific targets	National Restoration Plans	Periodic review	Guidelines and further specifications	An EU-wide methodology	Crosslinkages with LULUCF
Policy option 1								
Policy option 2	x			x	x	x	x	x
Policy option 3			x	x	x	x	x	x
Policy option 4		x	x	x	x	x	x	x

5.3. Options discarded at an early stage

Options such as **market-based instruments and financing alone**, were discarded because they are already proposed in section 3 of the Biodiversity Strategy for 2030 and thus form part of the baseline, and a range of financing sources at EU level exist and can already be used for ecosystem restoration. Furthermore, the evaluation of the Biodiversity Strategy to 2020 concluded that a reliance on voluntary instruments alone was a significant cause of the Strategy's failure and that the Strategy could have benefited from a different combination of regulatory instruments (such as legally binding targets) and market-based instruments.

The option of **revising existing legislation** was also discarded early on because revising several pieces of specific legislation does not provide sufficient coherence and timeliness to deliver the objectives outlined in previous sections, for which a unified and timely approach is necessary. The overarching framework for Member States to develop comprehensive National Restoration Plans would be missing. Such a framework would be necessary to bring together restoration action that is now scattered across different legal bases. At national level, it would furthermore help to break silos pushing all sectors engaged in restoration to come together to deliver a common plan. In addition, the national restoration plans would benefit from a Commission review and adoption to ensure their quality and consistency. None of this could be achieved by amendments to individual pieces of legislation.

Moreover, revising existing legislation would entail significant complexity, including for the co-legislators and for the Member States. If the Commission put forward several amendment proposals for different pieces of legislation, the ordinary legislative procedure would follow its separate course for each of them and it would be very difficult to ensure consistency across the board. This would also open the possibility for co-legislators to propose amendments to other provisions of existing legislation other than those strictly related to restoration. This could complicate the legislative process and alter the nature of the Commission proposals. Furthermore, for the BHD and WFD the respective Fitness Checks concluded that the legislation is fit for purpose but more efforts in implementation are needed to achieve results on the ground. A new binding instrument can indeed better define these implementation efforts, with no need to change the basis provided by existing legislation, in particular BHD and WFD.

In addition, revising several pieces of legislation would take much more time than establishing the proposed new one. Since the existing legislation is mainly composed of directives, each amendment, after adoption in the various ordinary legislative procedures, would need to be transposed in the national legal order of the Member States. The time required to make the new Commission proposals for amending the various Directives, the adoption by the co-legislations and the transposition of the revised Directives into national law would take several years. This would make it hardly possible to see substantial progress in restoration by 2030.

Finally, revising existing legislation would not easily allow for the establishment of an EU wide methodology for assessing ecosystem condition, and a coherent way of establishing further legally binding targets across a broad range of ecosystem types. Several such future targets could correspond to different legislative bases that would have to be revised separately, for example terrestrial targets with the BHD and marine targets with the MSFD. This would lead to difficulties in the coordination of such a methodology dispersed across several existing pieces of legislation. It would further complicate a stepwise approach to set future targets for further ecosystems, for which we currently do not have sufficient data, monitoring mechanisms, baselines and thresholds in place.

Other discarded options for targets are listed and described in Annexes V and VI respectively.

6. WHAT ARE THE IMPACTS OF THE POLICY OPTIONS?

Approach to impact assessment

The following sections analyse the policy options along the facets of effectiveness, policy coherence and efficiency.

Effectiveness

Effectiveness is the extent to which the option would achieve the specific objectives. Each policy option is assessed along dimensions that build on the definitions of SMART:

- **Specific**: Are the targets specific and will the option deliver specific results or only broad outcomes?
- **Measurable**: Are the targets and outcomes measurable?
- **Achievable and Realistic**: Is it feasible to attain the objective/targets of the policy options, or are they impossible to achieve? Are they within reach and deliver quality outcomes within the time frame?
- **Time-bound**: Do targets set a clearly defined timeline, including a target date?

- **Coordinated approach**: To what extent will this option deliver results across the EU in a harmonised manner, as opposed to only in some Member States. To what extent are common approaches used?
- **Comprehensive**: Does the option address a broad range of ecosystem types or only some?
- **Enabling measures**: Does the option include measures such as developing NRPs and financing sources that are channelled through NRPs?

Policy coherence

Policy coherence is assessed with respect to the EU policies linked to the biodiversity strategy and the Green Deal. This includes the four key pieces of EU biodiversity legislation, namely the BHD, WFD and MSFD, as well as Climate Law, Farm-to-Fork strategy and LULUCF regulation, and the CAP and CFP regulations.

Efficiency

The efficiency of options relates to their respective key economic, social and environmental impacts and benefit/cost ratio (cost-effectiveness). The efficiency of the options is assessed along the following impact types and measures:

- **Environmental impacts**: Impacts on biodiversity and ecosystems.
- **Socio-economic impacts:** Impacts, both positive or negative, economy and society wide or on business sectors such as agriculture, forestry and fisheries (including SMEs) water industries, tourism, and in terms of opportunity costs, transitional costs, compliance costs and reputational impacts.
- **Administrative impacts**: Monitoring and other administrative/enforcement costs in the EU and Member States for public authorities. In particular, it considers costs for the surveying of ecosystems, development of national restoration plans, administration and monitoring of ecosystems to be chosen for restoration, as well as for reporting. Administrative costs include the costs for enabling measures, as outlined in Annex VII section 5. They also include costs incurred by businesses and citizens.

Scoring

Policy options are analysed and scored along the above criteria as follows: (0) neutral, (1) slightly positive, (2) moderately positive, (3) positive, and (4) very positive. Scores are compared to the baseline, and so Option 1 by default scores 0 as it provides the reference level against which other options are assessed. It should be noted that because administrative impacts are mostly made up of costs, higher administrative costs will result in a lower score.

A more detailed overview of who is affected is provided in Annex III. Analytical methods to conduct the impact assessment are explained in Annex IV. Ecosystem-specific data availability issues are also explained in the ecosystem-specific impact assessments in Annex VI.

6.1. Impacts of policy Option 1 (Baseline)

The baseline describes the likely evolution of nature restoration and the condition of ecosystems in the EU towards 2030, and to the extent possible 2040 and 2050, *in the absence of legally binding EU nature restoration targets*. This is based on monitoring evidence on the state of ecosystems, previous experience in restoration governance and expert judgement. Annex VII provides a more detailed description of the baseline and potential impacts.

Effectiveness (score: 0)

Overall, effectiveness is expected to be neutral and will therefore not be sufficient to achieve the specific goals. The main reason for this is that voluntary targets have led to very little action in the past and the existing legal obligations for restoration have been poorly implemented.

The Biodiversity Strategy for 2030, without considering the commitment to put forward a proposal for legally binding EU restoration targets, sets out several restoration-related targets of which some are **specific and time-bound**. In theory the targets for 2030 are **achievable**, however, their voluntary nature makes their achievement unlikely. Furthermore, for several of the voluntary targets suggested in the Biodiversity Strategy, neither indicators nor baselines for measuring them are defined. **Coordinated action** across the EU is expected to be very low, based on the experience with the Biodiversity Strategy for 2020 that led only to three Member States producing restoration plans voluntarily. Specific targets suggested in the Biodiversity Strategy for 2030 address some ecosystems but not all; for example, there are no explicit targets for wetlands. Therefore, there is only limited **comprehensiveness**.

Furthermore, even though some targets specify percentages to be achieved, elements of the targets are not further defined nor explained, which means that Member States would be left with several questions on how to go about working towards these targets. As such it is unlikely that these targets without further guidance and additional **enabling measures** lead to **specific**, let alone measurable, **outcomes**. Due to these limitations of this option, the baseline as described in previous sections is considered unable to attain to the specified objectives.

Policy coherence (score: 0)

Option 1 is based on the BDS2030 but without legally binding targets, so is broadly speaking coherent. However, synergies would mostly be expected with policies and initiatives set out in the strategy to 2030 itself, but synergies with other policies are expected to be weak since there is no obligation to streamline legal processes, e.g. in terms of reporting. See section 5.1 for a more detailed description.

Efficiency (score: 0)

The baseline includes estimates of the effects of the continued implementation of existing forthcoming voluntary and mandatory commitments. It includes therefore the influence of continued implementation of the EU Birds and Habitats Directives, the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD), as well as other voluntary activities under the BDS 2030, and policies of the Green Deal, in particular the climate law and LULUCF, Farm to Fork, as well as the CAP and CFP regulations.

The baseline also describes some of the likely effects of climate change on ecosystems and likely ensuing trends, as well as the likely socio-economic trends.

In broad terms, the baseline is not expected to lead to major changes in ecosystem extent in comparison to the current situation, across the main ecosystem types. However, the **analysis indicates that despite the hopeful developments since the adoption of the EU Green Deal and the EU Biodiversity Strategy for 2030, and continued implementation of the nature directives, the expectation is that ecosystem condition will only slightly improve in the period to 2030 under the baseline scenario.**

In order to make some quantitative estimates, building on a previous study that made a quantitative assessment of the amount of restoration undertaken in the EU[119], it was possible to extrapolate how much could be expected to be restored in the future. This study had provided estimates of average **annual EU area** on which restoration action had been taken based on both binding and voluntary commitments and for all the main ecosystem types. **The extrapolation shows that restoration measures would only cover a fraction of the total EU area , or 0,71% by 2030, 1,50% by 2040 and 2,30% by 2050** (see Annex VII, section 1.1).

In summary, the baseline restoration effort is likely to remain at an insufficient scale to meet restoration needs. Furthermore, restoration is likely to happen too slowly to reverse the present, steep biodiversity decline and to underpin ecosystem resilience in the face of climate change.

While the changes in the extent and distribution of broad types of ecosystems in Europe between now and 2050 are less certain, there is greater certainty that the condition and ability to provide services of many ecosystems will not improve significantly and/or will worsen. Society and businesses (incl. SMEs), especially those that are directly dependent on nature, will experience negative impacts in the longer term. On the other hand, those businesses that benefit most from the status quo will, at least in the short term, benefit from the baseline model. Existing legislation and initiatives will not match the extent of measures required to achieve the objectives for any of the ecosystems.

Administrative impacts

[119] Eftec, ECNC, UAntwerp & CEEWEB (2017), Promotion of ecosystem restoration in the context of the EU biodiversity strategy to 2020. Report to European Commission, DG Environment. https://ec.europa.eu/environment/nature/pdf/promotion_of_ecosystem_restoration_in_the_context_of_the_EU_biodiversity_strategy_report%20.zip

The administrative costs are taken as 0, the reference level as this is the baseline. Costs of the baseline scenario and the assumptions of implementation it includes could be met through existing EU, Member States or private funds.

6.2. Impacts of policy Option 2 (Legally binding overarching target)

This policy option sets an overarching target that is legally binding (see Chapter 5).

Effectiveness (average score: 1.7)

This option would give impetus to restoration activity across Member States on a continued basis up to 2050. The goal is clearly **time-bound**. The milestone dates of the targets are useful but likely not to ensure **achievability.**

Under this option, and as described in section 5.2.1, Member States would be required to reach the target on their own territories, and would be required to set up national restoration plans to reach the overarching target. Each Member State would decide how to best achieve their target based on their geographical characteristics and national preferences, and the Commission could also provide guidance on which ecosystems to prioritise. In terms of implementation, Member States would have to monitor and then sum each of their specific restoration efforts and monitor how this would contribute to the overall target in terms of overall areas restored. These restoration efforts and the overall sum contribution to the target would be reported and checked against the target. Enforcement would entail checking for each Member State progress towards this overall target.

The main problem with this option is that of **enforceability**. As of today, only for some specific habitat types for which specific targets are outlined under option 3, is there an agreed common methodology for defining good ecosystem condition, and hence for determining what a degraded ecosystem is. This concerns in particular habitats covered by the Habitats Directive and water bodies and marine ecosystems under the Water Framework Directive and Marine Strategy Framework Directive. It is therefore currently not possible to assess how much of other ecosystems are being degraded in the EU or in a specific Member State and hence to what level progress will be made towards achieving the target. For example, we do not know how much of non-BHD annex I forest- or agro-ecosystems are currently degraded as there is no common methodology with specific thresholds for determining the level of degradation. That is, unless such a common methodology has been established and agreed in the EU with the Member States, it is not possible to assess the current baseline and condition of ecosystems in the EU and the Member States. This target is therefore **only partially measurable** , until the methodology would be fully developed. Without such a methodology, there would be a lack of common approaches for measurement and reviewing implementation progress.

Furthermore, this option could very easily lead to Member States prioritising the restoration of some ecosystems over others, resulting in uneven **coverage** across the main ecosystem types. Member States could also prioritise the cheaper options for restoration while giving insufficient attention to biodiversity benefits and while leaving out others that may be more costly to restore but would generate more biodiversity and societal benefits and have a better cost/benefit ratio. This too would result in sub-optimal outcomes and uneven coverage. Furthermore, the broadness of the target lends itself to a lack of **specificity**. This has been seen in the implementation of other directives with broad goals, such as the MSFD. It could therefore lead to Member States not taking sufficient action because of lack of specificity. Likewise, for compliance it may be difficult to prove that a Member State has not taken sufficient restoration efforts until the deadline for attaining the target has passed, whereas a more measurable target would enable a closer follow-up of the progress towards the target and intermediate milestones. Due to the limitations of this option the overarching target is considered difficult to attain.

Policy option 2: effectiveness	**Score**
Timing	3
Specificity	0
Measurability	1
Achievability	1
Coordinated action	3
Comprehensiveness	2
Enabling measures	2
Total	*12*
Average	*1.7*
Assessment	*Moderately effective*

Policy coherence (score: 1)

Option 2 is reasonably coherent with the **BHD**, **MSFD** and **WFD** as it can work together with these directives and would require Member States to draw up National Restoration Plans. However, it does not address the policy and legislative failures related to these directives, as outlined in section 2.2. First, while this option provides a restoration target that is both legally binding and time-bound, it only partially addresses the 'time-bound gap' of the **BHD**, since there are no deadlines for specific ecosystems. This would increase the risk of Member States deciding to postpone restoration of some ecosystems to later dates even though more rapid action could be needed. Overall, this would contribute to a lack of coherence and some ecosystems being addressed more quickly than others across the EU. Second, the overarching target does not provide specific targets, measures and monitoring for specific habitats or species, thereby not addressing the 'specificity gap' of the **MSFD**. Third, this lack of specific restoration targets for both freshwater and the surrounding habitats, including barrier removal, would not address the needed interlinkages between the **WFD and the BHD,** in particular for riverine and alluvial habitats. Fourth, this option does not sufficiently address the directives' broader gap of not explicitly addressing those ecosystem types that are currently not covered by legislation; thus, for example the particular emphasis needed for the restoration of soils or non-annex I forests, or others would not be dealt with explicitly, and could lead to the insufficient restoration of these ecosystems.

The target is in line with the ambition level of the **Green Deal**. However, because Member States could define and design their own monitoring systems for any targets beyond those Annex I habitats and protected species under the nature directives, there would be less opportunity to link these with existing EU methods and standards, leading to potential inefficiencies and incoherence.

The overarching target is directly aligned with the **Biodiversity Strategy for 2030**'s headline ambition "to ensure that by 2050 all of the world's ecosystems are restored, resilient, and adequately protected". The binding nature of the target would give considerable impetus for Member States to fulfil the strategy's voluntary commitments that support restoration under the baseline, for example stopping deterioration of protected habitats, increasing organic farming, reducing pesticide and fertiliser use, and improving soil health, reversing the decline of pollinators, introducing landscape features, planting trees, restoring free flowing rivers, reducing the number of invasive alien species, reducing bycatch and damage to seabeds, and stopping the loss of green urban ecosystems. It may, for example, encourage Member States to make optimal use of the **CAP** funds and ecoschemes to finance restoration.

However, again, Member States would not be required to prioritise specific key species or habitats with high biodiversity value. Instead, they would be free to "cherry pick" what ecosystems to restore first, what voluntary targets to contribute to, what measures to use, and how to define attributes and monitor progress. This large degree of flexibility would lead to uneven and incoherent implementation.

In sum, due to the broadness of the target and lack of specific links to other legislation and initiatives, this option is assessed as *slightly coherent*.

Efficiency (average score: 1.7)

A more detailed analysis is provided in Annex VII, option 2.

Environmental impacts (score: 2)

A clearly positive aspect of this option is that a single, easy to communicate legally binding target would facilitate building broad awareness of EU ambition on nature restoration. It could help ensure buy-in across stakeholder groups and could help put biodiversity on par with 'headline' climate targets such as achieving climate neutrality.

Member States would have quite a degree of freedom and flexibility in choosing which ecosystems to prioritise for restoration. There would be a high degree of freedom also in the sequencing of ecosystem restoration (which to start with and which to leave for later) since the overarching target would require restoration of most ecosystems by 2050 and their maintenance. An evaluation was made to map the decision-making factors that would guide the direction of ecosystem restoration by Member States. A summary table is provided in Annex VII, option 2.

The main disadvantage of a broad overarching target (rather than ecosystem-specific targets) is that it would probably result in uncertain and uneven rates of restoration of ecosystems in the Member States, at least in the short-medium term. Moreover, the goal may not even be reached on time, as it has been evidenced in other pieces of legislation with very broad goals such as the MSFD. Member States are likely to prioritise which ecosystems to restore first, as described above. However, the goal would provide the impetus and would thus increase the scope and magnitude of implementation. Thus, compared to the baseline there is an even greater risk that this could result in the "picking of low hanging fruit", i.e. prioritisation of restoration of ecosystems that are easiest and least expensive to restore, or with the most immediate service benefit. This in turn could lead to an implementation effort that would be unbalanced. For those ecosystems for which indicators have to be developed, the lack of a common, EU wide approach would lead to uncoordinated approaches across Member States. This would all lead to not very positive consequences for biodiversity.

Consequently, this option would result in only moderately positive outcomes for the ecosystems and biodiversity. Ecosystem condition would likely improve across the EU albeit in an uneven manner. It would fail to restore biodiversity to the level required to meet EU-wide and international biodiversity objectives. See Annex VI for the more detailed thematic impact assessment.

Socio-economic impacts (score: 2)

In overall terms, the overarching target would spur increased restoration action which would likely benefit biodiversity and ecosystem services. However, as over time biodiversity would continue to degrade further in various ecosystems not prioritised for restoration, this would in the medium to long term still undermine the provision of their services as well as increase future restoration costs. Therefore, with this option one would probably see moderate overall net ecosystem service benefits in the short-term, but probably lower net benefits towards 2040-2050. This would lead to only moderately positive results for society at large and businesses since ecosystems services will not be delivered to their full potential. There would be costs for farmers, for example in terms of potentially lower yields, even if quality would be likely to increase in the medium to longer term. Fishers would also have initial costs, that in the longer term would be compensated by improved fish stocks in the future.

Administrative impacts (score: 1)

Several administrative impacts can be expected, including costs for the surveying of ecosystems, development of national restoration plans, administration and monitoring of ecosystems to be chosen for restoration, as well as for reporting. These costs for 27 Member States together are estimated to amount to nearly EUR 14 billion until 2050. See Annex VII section 4 and Annex III for more details on administrative costs.

Administrative costs for option 2		
	One-off costs	***Annual costs***
Surveys of ecosystems	1 099 000 000	
Development of national restoration plans;	12 800 000	
Administration of restoration measures (2022-2030; 15 % target)		438 321 000
Monitoring of restored ecosystems		20 643 103
Reporting progress against restoration targets		107 000
Sub-total	***1 111 800 000***	***459 071 103***
Costs from 2022 to 2050	***1 111 800 000***	***12 853 990 884***
Total costs from 2022 to 2050		***13 965 790 884***

6.3. Impacts of policy Option 3 (Ecosystem-specific targets)

In this option, the EU sets a number of ecosystem-specific targets. An analysis of policy coherence and effectiveness is provided, as well as an analysis, ecosystem by ecosystem, of efficiency **based on the targets selected for step 1 as listed in section 5.2.1 (as well as in Annex V). Specific details are provided in Annex VI, based on thematic impact assessments for each ecosystem, and for which specific targets are selected.** In each ecosystem-specific analysis for efficiency, if monetary costing was possible, this included restoration, re-creation and maintenance costs and to some extent opportunity costs. See Annex IV for an overview of the analytical methods used.

Effectiveness (average score: 3.4)

The targets proposed have been analysed in each of the thematic assessments. Options were considered for the targets, of which certain targets were discarded. The table in Annex V shows the selected (and discarded) targets following each thematic impact assessment. Each target is ecosystem-specific or in some cases addresses **specific** species that are representative of the health of underlying ecosystems. All are clearly defined and with **deadlines** and many with defined milestone dates.

For any target that builds on the monitoring mechanisms of the BHD, **measurability** is assured, since the targets build on existing definitions of favourable conservation status and description of Annex I habitats. The targets are specified by the area (in km^2) for which restoration measures have to be completed, and this further enhances monitoring and measurement. For any targets specified for which monitoring mechanisms are not yet defined, the process of establishing the EU wide methodology and monitoring framework would assure measurability of those targets once established in step 2.

The targets are **achievable**. They are based on clear definitions, such as ‘good ecosystem condition’, and ‘ecosystem recovery’; see glossary. They take account of the fact that ecosystems can take long times to recover, by specifying that the necessary restoration measures be put into place, with subsequent recovery of the ecosystem as a result. Another aspect of the target also specifies that restoration does lead to good condition, i.e. based on the ecological indicators (for example following from structure and function parameters of the HD). A similar approach is also used in the definition of the marine target, since for marine the actual recovery of marine ecosystems can take long periods of time, in some cases beyond 2050. Based on the above, the targets are both achievable (allowing for recovery) and measurable (mainly based on areas that can be monitored). The inclusion of milestones also contributes to achievability and the thematic assessments considered the most efficient options for the rate of restoration in the period up to 2050.

The two-step approach assures that for those ecosystems for which data and monitoring mechanisms do not exist, further targets can be established in step 2. This EU-wide methodology ensures that Member States take actions in a more **coordinated manner** than in option 2. Targets are defined and foreseen for each main ecosystem type, ensuring a **comprehensive** approach.

For those targets based on monitoring mechanisms linked to the Nature Directives, it is important to point out that these targets will contribute to *much more than restoring inside protected areas*, since they address Annex I habitats both inside *and* outside the Natura 2000 network of protected areas. Also, it should be noted that "re-creation" would include the conversion of non-Annex I habitats back to Annex I habitats; for example the conversion of a grassland that was created on the basis of a drained wetland, back into a wetland. These correspond to significant areas. On the basis of EEA calculations based on data officially reported by Member States under Article 17 of the Habitats Directive, it is estimated that restoration of Annex I habitats would cover between 182 985 and 536 669 km^2 on land (5-14 % of the terrestrial EU area, at least the area of Greece & Belgium together); re-creation would cover a minimum of 10 703 km^2 on land. This ensures further **comprehensiveness**. Similarly the targets concerning protected species cover areas going well beyond protected areas. The foreseen **enabling measures,** described in the implementation framework such as NRPs, periodic review, an EU wide methodology and further guidance, would further contribute to Member States to achieving the ecosystem-specific targets. In sum, the various aspects of this option makes it feasible to attain the policy objectives, and is therefore considered effective.

Policy option 3: effectiveness	**Score**
Timing	3
Specificity	4
Measurability	3
Achievability	3
Coordinated action	4
Comprehensiveness	4
Enabling measures	3
Total	*24*
Average	*3.4*
Assessment	*Effective*

Policy coherence (score: 3)

Option 3 establishes much increased coherence. This option is closely knitted with the BHD, WFD and MSFD. The set of ecosystem-specific targets proposed make use of the ecosystem measurement and monitoring methodologies of the **BHD**. The targets also address the major gap of the BHD by introducing time-bound targets, and apart from setting a number of ecosystem-specific restoration objectives these would also help accelerate the implementation of the Directives. It acts as a complement to the **WFD** since what is addressed is the attribute of free-flowing rivers, an aspect that is not addressed in the Directive. The specific target on river, lakes and alluvial habitats, works in synergy with the WFD and BHD by focussing on the interactions between water bodies, such as rivers, and the surrounding terrestrial riverine habitats. The specific marine target will work in synergy with the **MSFD** in that it specifies habitats based on BHD Annex I descriptions and that are at a scale that is needed for restoration; acting as a complement to the broad MSFD goal and the eleven broad descriptors that contribute to Good Environmental Status. The option with ecosystem-specific targets thus dovetail well with the four respective Directives, provide synergies, and would also help accelerate their respective implementation. See also Annex X referring to added value and synergies.

Targets on wetlands, forests, heath and scrub, soil organic carbon, grassland and on marine habitats such as sea grasses, will contribute significantly to climate policies that promote carbon removals, such as **LULUCF**, while the target(s) on urban, coastal wetlands and riverine habitats will contribute to disaster risk reduction and **climate adaptation**. Furthermore, the proposed additions to the monitoring requirements under LULUCF, based on land categories that contribute to carbon removals defined on the basis of environmental legislation, establish important cross correspondence. In the longer term, this would enable more exact estimates of the carbon removals based on the areas of specific ecosystems restored.

Targets on improving soil organic carbon would support initiatives under the **Soil Strategy**. The ecosystem-specific targets on agroecosystems and grasslands would provide benefits to the **CAP** and vice versa funding opportunities of the CAP could also be made use of for the purpose of restoration in the National Restoration Plans. These would work in synergy with the targets under the **Farm to Fork Strategy** (F2F), such as on the reduction of use and risk of chemical pesticide, and on nutrient loss and on promoting carbon and organic farming. The target on restoring a number of marine habitats would contribute to the **CFP** by ensuring better conditions for fish spawning and overall condition of fish stocks. The forest targets would provide support for implementation of the **Forest Strategy**. More information on the relation between the proposal for legally binding restoration targets and other EU legislation and policy initiatives can be found in Annex X.

Efficiency (average score: 3)

Overall impacts of ecosystem-specific targets

Member States would be obliged to achieve the restoration targets corresponding to each of their national territories, as applicable to their national biographical situation (for example land-locked Member States would obviously not have the obligation for any marine restoration). Typically, many of the targets require degraded areas of ecosystem to be restored, so countries with larger areas of degraded ecosystems would require relatively more to be restored. Overall, this means that the obligation of each Member State will be not only proportionate to the extent of its territory and sea, but also on the level of degradation of the ecosystems on its territory and its sea, i.e. reflecting the past and present pressures affecting them.

There are also some general observations that can be made in terms of the distribution of specific ecosystem types across Member States. For marine ecosystems, Member States with the large Exclusive Economic Zones (EEZs) and (where applicable) continental shelves would have large areas for potential restoration. For terrestrial ecosystems, northern Member States have the largest areas of peatlands and forests to restore, southern Member States have a larger areas of coastal wetlands; steppe, heath & scrub, and agro-ecosystems. Central and eastern European Member States have the largest areas of forests, rivers and lakes, and grasslands. So, while ecosystems do not occur equally in all regions of the EU, based on the data estimates, the *overall* contribution to restoration are expected to be rather well distributed across all Member States.

Furthermore, as shown earlier in this section, the analysis shows the benefits of restoration outweigh the costs of restoration, across each of the main ecosystem types, and in some cases significantly. Thus, **countries with larger areas to restore also stand to make greater overall benefits in the longer term.** Annex III provides a detailed analysis of impacts on Member States for a selection of ecosystems, with a numerical analysis of costs and benefits for Member States. Based on the analysis of impacts, **these results show the significant benefits that Members States and the EU as a whole stand to gain.**

The positive impacts of restoration are likely to be distributed across society as a whole; for example, the benefits of reduced risks of disasters, better air quality, better water quality, the benefits of carbon mitigation, etc.

However, **some impacts both positive and negative are more likely to focus on specific stakeholder groups**. For the set of targets considered, the main stakeholders **groups** identified that could be affected by the targets are economic operators in the primary sectors most directly dependent on ecosystems, such as farmers, foresters, fishers and landowners.

On the negative side, these groups could stand to lose income in the short term due to more stringent restoration requirements. For example, farmers may lose income if due to wetland restoration they cannot use their land due to more frequent flooding of restored floodplains or raised water tables from re-conversion of neighboring lands to wetlands (e.g. as part of peatland restoration). Fishermen may see restrictions in fishing areas and -techniques e.g. in protected areas. Foresters will be expected to leave larger areas of their forests in an undisturbed state and lower logging intensity as part of closer to nature forestry approaches. However, it should be borne in mind that most if not all of such foregone incomes can already be compensated for totally or partially under EU funds such as the CAP, the EMFF, the Just Transition Fund and others, as well as under various national funds in most EU Member States.

On the other hand, many of **these stakeholder groups are likely to directly stand to gain, due to improved ecosystem condition**: for example, future crops yields are likely to be more stable e.g. due to greater resilience to pests and extreme weather events. Fish abundance would increase as spawning areas such as shellfish reefs and vegetation can recover and marine ecosystem health improves. Restored forests will be less vulnerable to forest fires due to a more diverse distribution of tree species. These will all have direct positive effects for farmers, fishers, foresters and landowners. Furthermore, new forms of incomes will become available for these groups, based on new business models that incorporate income diversification based on a range of ecosystem services. For example, diversification of incomes based on various ecosystem services will enable increase incomes stemming from tourists and recreational activities since many ecosystems that are in good health are primary locations for quality tourism. A specific example, is the development of rural and agro-tourism in areas that become more interesting to visit because of their improved natural qualities.

Annex III provides a further analysis of impacts on stakeholders and specific stakeholder groups based on a qualitative assessment.

Impact analysis, ecosystem by ecosystem, based on the targets selected for step 1 as listed in section 5.2.1 (policy option 3) and in Annex V.

Annex VI provides a more detailed of cost and benefits and here overview is provided for each ecosystem type. This is then summarised in the benefit to cost tables provided below and in Annex III. It should be underlined here that **for each ecosystem type the benefits are estimated to outweigh the costs, and in some cases significantly**. Typically costs arise from various estimates of how much it costs to restore specific ecosystems per hectare. **Benefit estimates** draw on the socio-economic benefits of improved ecosystem services, such has contributions to food provision, water purification, raw materials, genetic resources, medicinal resources, air quality regulation, climate regulation, moderation of extreme events, regulation of water flows, erosion prevention, maintenance of soil fertility, pollination, opportunities for recreation and tourism and others. The estimates and calculations are based on an extensive review of literature of the value of benefits of restoration, and were calculated for carbon storage and sequestration and total ecosystem service values (so including carbon benefits). A broad scope was taken to the estimation of total benefits, while avoiding overlaps, to obtain as full a picture of total benefits as possible. The types of benefits accounted for are similar between ecosystems, with some differences mostly caused by differences in services provided between different ecosystems and the scope of available studies on which median estimates were based. The table below provides a (non-exhaustive- overview of benefits identified beyond biodiversity and carbon benefits which were assessed for all ecosystem types, as well as the number of studies consulted to obtain a benefits estimate. A more detailed description of the analytical method is provided in Annex IV.

Ecosystem type/species	Types of benefits identified
Inland wetlands	Flood alleviation; water quality improvements; recreation- and other cultural services.
Coastal and other saline wetlands	Storm surge mitigation; protection against coastal erosion; water filtration; fish stock restoration; recreation and other cultural services.
Forests	Timber products and non-timber forest products, water- and soil quality, flood prevention, increased resilience against natural disturbances (droughts, fires, pests, and diseases); recreation- and other cultural services.
Agro-ecosystems	Food and fibre; water quality; flood management; pollination; soil quality; erosion control; climate regulation; cultural services (recreation, landscape, aesthetic values).
Steppe, heath and scrubland	Erosion control; water quality; flood management; fire prevention; food and fibre; cultural services (recreation, landscape and existence values).
Rivers, lakes and alluvial habitats	Fresh water; fisheries; genetic resources; waste treatment; water quality; flood management; soil quality; cultural services (landscape, aesthetic, inspirational and recreational).
Marine ecosystems	Flood mitigation, erosion control, water quality, food and fibre (including indirectly through fish stock regeneration), recreational services.
Urban ecosystems	Health and wellbeing; cooling and insulation (e.g. against urban heat island effect); recreation; food- and fibre; flood risk reduction; water quality; air quality, noise reduction, property value.
Soil ecosystems	Water quality; flood risk mitigation; drought risk mitigation; pest control; reduced input costs; soil subsistence and -degradation prevention (and herewith resilience of food- and fibre).
Pollinators	Sustainable provision of animal-pollinated crops and associated benefits; healthy ecosystems dependent on the diversity of wild animal-pollinated plants (and wide-range of regulating ecosystems based on them); cultural, aesthetic, wellbeing.

Coastal wetlands *(see also Annex VI for a more detailed analysis)*

The restoration of coastal wetlands, based on the targets selected, would offer unique habitat conditions for threatened species, especially bird species protected under the EU Birds Directive, and restoration will enhance and further support the return of biodiversity.

Despite representing a comparatively small area among all wetland habitats, coastal wetlands provide significant disaster risk prevention services, increased resilience to climate change impacts, and carbon sequestration services, thus contributing to the EU climate objectives. As communities become increasingly urban and coastal, with some projections estimating that by 2060, 55.7 million people in Europe will live in coastal zones, the more we will need coastal wetlands to serve as protective barriers from coastal storms that become increasingly unpredictable and violent.

Coastal ecosystems provide vital services for agriculture and fisheries. Those working directly and indirectly in the aquaculture and fisheries industry may be impacted by restoration/protection measures, e.g. on where to locate aquaculture facilities, but in the longer term would benefit from higher and more resilient catches as habitats for commercially important species, such as shellfish, recover. Farmers may be impacted, for example, by measures needed to limit the amount of nutrient run-off and pollution that can enter a coastal wetland. Opportunity costs could stem from reduced possibilities for using these coastal areas for other economic activities such as construction. On the other hand, the tourism industry would benefit as these ecosystems are primary locations for touristic activities.

The total cost of coastal wetland activities to reach the targets falls within the range of EUR 5.1 to 5.8 billion. While these costs may be high given the relatively small area of coastal wetlands, they are comparatively low to the benefits that these ecosystems provide in terms of their ecosystem services. Benefits such as from storm mitigation, water filtration, and fish stock restoration, amongst others, are valued between EUR 182 to 223 billion. The analysis estimates that the monetised benefits for carbon storage alone areare less than the estimated costs of full ecosystem recovery (i.e. to good condition), with a**benefit**a**-cost ratio ofof 0.2.** However, ifi other above-mentioned ecosystem service benefits are included, the estimated net benefits increase markedly, with a **benefit-cost ratio of between 35 and 38**.

Evidence suggests that coastal wetlands respond quickly to restoration efforts, with many of the benefits of ecosystem restoration observed within five years, but that some habitats such as saltmarsh may take more than 100 years to recover their full biodiversity[120] (Maskell et al, 2014).

Inland wetlands *(see also Annex VI for a more detailed analysis)*

The effects of the targets selected would be very positive for biodiversity and ecosystem services, most notably in terms of carbon sequestration and storage, water quality, flood risk management, erosion control and cultural services. Marshes are particularly important for birds listed in Annex I of the Birds Directive, as well as other migratory species. The restored peatlands would be particularly effective in maintaining carbon stores, and with time recovery of vegetation, carbon sequestration and several other ecosystem services would increase.

Peatlands have a large carbon mitigation potential, however, currently peatlands, because they are degraded, are estimated to emit around 220 MtCO2e/yr in the EU[121]. Restoring peatlands, such as by rewetting, can protect carbon stocks in organic soils, and sequester carbon as the degraded land recovers. It can also help improve water quality, protect

[120] Maskell L, Jarvis S, Jones L, Garbutt A and Dickie I (2014) Restoration of natural capital: review of evidence. Report to the Natural Capital Committee, UK. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/517024/ncc-research-restoration-natural-capital-review.pdf

[121] Tanneberger, F., Appulo, L., Ewert, S., Lakner, S., Ó Brolcháin, N., Peters, J., & Wichtmann, W., *The Power of Nature-Based Solutions: How Peatlands Can Help Us to Achieve Key EU Sustainability*, 2021.

against flooding, provide habitats for biodiversity, and can still be used for agriculture production through paludiculture. Rewetting just 3 % of agricultural land in the EU will save up to 25 % of agricultural greenhouse gas emissions[122].

Uncompensated opportunity costs as a consequence of establishing the targets can be expected to be minor in relation to the restoration of HD Annex I peatlands and marshlands. Firstly, under the CAP, Member States will have to define the protection that will be applied to peatlands and, if deemed appropriate, will define more ambitious management requirements on wetlands and peatlands, which will be set under Pillar I eco-schemes or Pillar II management commitments. Secondly, because of the increasing recognition of the potential carbon losses from degraded peatlands, damaging activities are now largely prohibited within areas of HD Annex I peatlands. Consequently, lost peat extraction opportunity costs are expected to be small.

The main stakeholders affected by the targets are farmers, landowners and land managers who would undertake the required restoration actions. Farmers' additional costs and income foregone could be covered totally or partially under the CAP, if the Member States make such a choice in their Strategic Plans. In turn, the restoration work will create employment and income for farmers, land managers and contractors in the medium to longer term, and restored areas can provide new sources of income such as eco-tourism. Beneficiaries would include the entire population and economy (through carbon and biodiversity benefits), as well as water companies and consumers, and the tourism sector.

The monetised benefits for carbon storage and sequestration from peatland restoration are estimated at EUR 10.6 to 13.0 billion. They outweigh the estimated costs of full ecosystem recovery (i.e. to good status), estimated at EUR 4.8 to 5.1 billion, and have a **benefit cost ratio ranging from 2.2 to 2.5**. If overall ecosystem service benefits for restored peatland and marshland are applied, the estimated net benefits increase markedly (EUR 45.1 to 55.3 billion), with a **benefit cost ratio of between 7.1 and 8.3** for peatland and between 1.8 and 2.1 for marshland.

Evidence suggests that restoration of wetlands can deliver benefits for biodiversity and ecosystem services quickly but that full recovery of biodiversity may take decades. For example, restoration of blanket bog may achieve improvements in hydrology in 1-2 years, carbon emissions in 3 years and vegetation re-colonisation in 2 years; however full vegetation communities may take 20-50 years to return (Maskell et al, 2014).

Marine *(see also Annex VI for a more detailed analysis)*

Restoration of marine habitats can be a particularly effective way to achieve the recovery of whole marine ecosystems, including species. Science shows that restoring marine habitats (where species live, reproduce and forage) both sets the enabling conditions for species and ecosystems to thrive and allows delivering enhanced ecosystem and societal services. The groups of habitats that are proposed for restoration (seagrass beds;

[122] Position Paper: *Preserve peatlands in post-2020 CAP*.

macroalgal forests; shellfish beds; maerl beds; sponge, coral and coralligenous beds; seeps and vents; and soft sediments) have the capacity to contribute substantially to the restoration objectives under the Biodiversity Strategy, in particular towards mitigating climate change, reducing the impact of natural disasters and bringing health, social and economic benefits.

Estimates of the costs of marine restoration vary considerably depending on the habitat, its location, condition, scale, and method used. Benefit calculations are difficult to evaluate with precision, but rather give order of magnitude estimates. Opportunity costs may include foregone income for fishers, or reductions in exploitation of natural resources, such as sand or mineral resources. In the short-term, impacts would be mainly on the fisheries sector in terms of potential lost income and revenues. However, benefits from increased catch would be seen in the medium to long term, and EU funds (e.g. the European Maritime Fisheries and Aquaculture Fund, EMFAF) are available to partially mitigate the initial impacts. Other economic sectors that would be impacted include mining, agriculture, aquaculture and leisure. However, many local stakeholders would benefit in the medium to long term from improved water quality, improved seascapes and richer biodiversity.

Details on the costs and benefits of the selected habitats are provided in Annex VI. As a specific example, seagrass provides benefits for climate mitigation, flooding and erosion approximated at EUR 95 per ha/year as well as benefits for food, water and raw materials valued at EUR 866 per ha/year. No financial valuation is available for ecosystem services for cultural (e.g. recreation, wellbeing, aesthetic value, etc.) or other socio-economic purposes (e.g. coastal tourism), however, these are expected to be significant. The costs of sea grass restoration have a wide range of estimates for both active and passive restoration.

However, given the high variability in the economic cost and benefits of restoring marine habitats, the taxonomic and geographic biases in the availability of information and the lack of a baseline to determine the area of degraded habitat that needs to be restored, it is not possible to estimate – with a degree of certainty – the exact costs of the proposed policy option nor the economic benefits obtained. However, **benefits very likely to outweigh the costs, in particular in the long term.**

In summary, the analysis suggests that of the selected marine habitats, these could be fully recovered in a timescale only *beyond* 2050, with partial recovery reached in 2030, 2040 and 2050. This is due to long recovery times of marine ecosystems and coupled with additional risk factors due to climate change. It is only in this longer-term timescale that the full biodiversity, fisheries and climate benefits may be felt. Benefits of restoration to biodiversity and fisheries have the potential to be realised within a decade (varying by habitat) whilst the benefit of restoration to climate change mitigation, adaptation and pollution effects, may take multiple decades. As such, restoration should start as soon as possible, even if the benefits are not immediate.

Freshwater *(see also Annex VI for a more detailed analysis)*

It is important to underline that this thematic impact assessment considers targets relevant to the entire river ecosystem including riverbanks, floodplains and areas next to rivers that may be covered by water during floods. The outcomes of applying the selected targets would contribute to improving the good ecological status of the waters and improving the condition of the surrounding habitats. This in turn will improve the delivery of a wide range of ecosystem services such as drinking water, fish supply, flood protection, water purification as well as recreational and cultural values. In addition, there will be important contributions to climate change mitigation, as well as to reducing seasonal and annual flood patterns.

Restoration actions are likely to benefit a range of stakeholders, including (1) local populations through increased safety and house prices due to decreased flood risk potential; (2) water suppliers and consumers through overall reduced water pollution and increased availability; (3) recreational users of freshwater ecosystems through greater access to previously restricted areas (due to barrier removal) and enhanced aesthetic values; and (4) society at large through enhanced ecosystem services. The benefits are estimated at EUR 862 to 1 053 billion.

Cost would arise from restoring the Annex I habitats and by recreation, and this could incur opportunity costs of similar nature to agro-ecosystems and wetlands. The removal of obsolete barriers may also involve opportunity costs, as compensation to stakeholders whose economic activities or assets are impacted by the removal of such barriers. Costs can also be expected for farmers whose management practices might need to change to restore degraded habitats, and whose land and crops would be impacted by, for example, likely frequent flooding following barrier removal. Total costs are estimated at EUR 35 to 40 billion.

Based on the estimates provided, and considering the variations in costs and benefits estimates, it is likely that **the benefit cost ratio deriving from all selected targets would range from 24 to 26.**

Evidence suggests that the full benefits for biodiversity and ecosystem services of restoration of rivers and lakes are likely to be seen within a period of 15-25 years, but that some species may recover within a few years of restoration (Maskell et al, 2014).

Steppe, heathh and scrub, rocky & dune habitats *(see also Annex VI for a more detailed analysis)*

The outcome of implementing the selected targets on heath and scrub habitats would deliver substantial benefits for biodiversity, society and the economy (especially farming and tourism). These include carbon storage and sequestration, whose benefits are valued from EUR 232 to EUR 1 337 per ha/year, as well as other regulating services (wildfire prevention and erosion control), provisioning services (maintenance of sustainable grazing) and cultural services (landscape, recreation and tourism and existence values), whose benefits are valued from EUR 558 to EUR 9 580 per ha/year. Total benefits are estimated at EUR 24 to 29 billion. For rocky and dune habitats benefits are mainly for biodiversity and recreational services, but can only be estimated in qualitative terms. There is evidence that restoration of heathland can result in recovery of vegetation and enhancements of some ecosystem services within 5 years, but that the full recovery of biodiversity will take longer (Maskell et al, 2014).

The costs of restoration will be incurred by farmers, who could in turn be compensated, for example through incentive payments possible under eco-schemes of the CAP. At the same time, restoration work are likely to create employment and enhance the possibility of diversified incomes for farmers and landowners. Total costs for the restoration of heath and scrub habitats over the entire period are estimated at EUR 3.051 to 3.111 billion.

The benefits of restoring Annex I heath and scrub habitats alone are estimated to exceed the restoration costs, even in a scenario where only carbon benefits are considered. **Benefit-cost ratios of are estimated from 1.3 to 1.5 based on carbon benefits alone**, and **from 7.9 to 9.2 if the total value of ecosystem services is considered.**

Pollinators *(see also Annex VI for a more detailed analysis)*

The pollinator target addresses insects, such as bees, hoverflies, butterflies and moths. The establishment of the target would address a decline in these species that has been particularly dramatic in the last thirty years; for example, the population trends of 17 butterfly species in 17 Member States showed a decline of 42-46 % between 1990 and 2017.

Restoring pollinators would result in benefits to various stakeholders, including land managers (e.g. farmers and beekeepers) and their supply chains, due to the biological control of pests, as well as decreased frequency of cutting/mowing and weed control activities, as a result of land management changes. The wider public would also benefit, as well as owners of gardens, and users of green and flower-rich spaces, providing enhanced cultural and wellbeing benefits.

Opportunity costs were estimated the same as for restoring Annex I grasslands, heath and scrub habitats. However, these are not additional costs as already covered under the respective targets. The recreation of Annex I grassland on arable land will have opportunity costs of lost agricultural production potential; however, this type of restoration is likely to be carried out on low productivity arable land and/or land that has a low-price value.

There are few estimates of the benefits of crop pollination in numerical terms. A European study estimated that pollinators are directly responsible for 7 % of crop yield in the EU, and that the crops dependent on animal pollination generate around 31 % of the income from EU crop production. The value of crop pollination was estimated at almost EUR 5 billion per year (value in 2019) for insect pollinators in the EU[123]. Beyond that a range

[123] Vysna, V., Maes, J., Petersen, J.E., La Notte, A., Vallecillo, S., Aizpurua, N., Ivits, E., Teller, A., Accounting for ecosystems and their services in the European Union (INCA). Final report from phase II of the INCA project aiming to develop a pilot for an integrated system of ecosystem accounts for the EU. Statistical report. Publications office of the European Union, Luxembourg, 2021.

of service benefits can be described and analysed in qualitative terms as described in Annex VI. These qualitative values are likely to be significant.

The costs of restoration, which would be borne by both public and private landowners, which were included in the estimats of restoring Annex I grassland, heath and scrub habitats to good condition. However, these are not additional costs as already covered by other targets. The costs of actions for pollinators on intensively managed farmland overlap to some degree with actions for farmland birds but may not be identical. Further costs would include the costs of establishing a dedicating monitoring scheme estimated at €154 million. Overall, the analysis indicates, **based on a combination of qualitative assessment and limited numerical data, that the benefits would outweigh the costs**.

Forest ecosystems *(see also Annex VI for a more detailed analysis)*

The selected targets on forests would have several benefits, most notably for biodiversity and ecosystem services such as (1) including more diversified timber and non-timber products with indirect economic benefits for the broader forest-based sector in terms of market value and employment; (2) regulating services including water and soil quality, flood prevention, carbon sequestration and storage, and increased resilience against the projected increase in natural disturbances under climate change (droughts, fires, pests, and diseases); and (3) social and cultural services in terms of aesthetic, recreational and existence values.

Enhanced services will have positive impacts more broadly on the economy, providing employment opportunities and income for the tourism/recreation sectors, conservation organisations, especially in rural economies.

Principal actors involved in the restoration of forest habitats will be forest owners and forest managers. Forest ownership varies from very small and fragmented private-owned to large scale state-owned forests, and from small family-owned holdings to large estates owned by private companies. Around 40 % of the forest area in the EU is publicly owned. Around 60 % of the EU's forests are in private ownership, with about 16 million private forest owners. Across the EU there are major variations in ownership of forests.

Opportunity costs could stem from decreased biomass harvests. These would involve economic costs for forest owners and the forest-based sector, in terms of market value and employment. Afforestation and reforestation activities may include additional costs and foregone income (such as costs for preparation of the soil, for the planting trees and related maintenance) for landowners and changing land use. At the same time foresters will be able to gain in the medium to longer term, since restored forests can provide new sources of income such as eco-tourism, or based on public and private payment schemes for ecosystem services.

A cost-benefit analysis for forest restoration in the EU is complicated by several factors, including the variety of forests across the EU and a lack of comprehensive and reliable data at EU level. An estimation of restoration costs ranges from EUR 50 to 54 billion, whereas an estimation of benefits ranges from EUR 204 to 250 billion (of which

EUR 3.8-4.7 billion consists of carbon benefits). This suggests that even without carbon benefits included, the benefits from restoration would exceed the costs. The estimated carbon benefits represent less than 10% of estimated costs, but are likely to be a significant underestimate.

Evidence suggests that forest ecosystems take a long time to restore, and that the full benefits of restoration may take many decades to be realised (Maskell et al, 2014).

Agro-ecosystems *(see also Annex VI for a more detailed analysis)*

The targets on agro-ecosystems will deliver substantial benefits for biodiversity, benefiting a wide range of species. Many semi-natural ecosystems and associated landscapes once restored, become highly species-rich. These will provide direct benefits to farmers and the agricultural sector, such as benefits from improved soils quality, reduced soil erosion and soil compaction and greater abundance of pollinators.

More widely, the targets will benefit sectors of the economy by enhancing the delivery of a variety of ecosystem services, including provisioning services (sustainably produced or organic food products based on sustainable agricultural practices), regulating services (climate, water quality, soil, quality water provision and improved flood management). They will also benefit the population at large, and tourism, through improved landscape quality and public enjoyment of the countryside. Overall, benefits are estimated at EUR 230 to 250 billion.

At the same time, expected costs are estimated at EUR 26.559 to 27.732 billion. They include costs for farmers in relation to the restoration and re-creation of agro-ecosystems; for example, the costs of switching to new more ecologically favourable management methods to maintain ecosystems in good condition. However, these are likely to be reduced since these can be funded under the CAP. Furthermore, any restrictions to practices brought about by implementation of the targets (such as restriction on the conversion or on the ploughing permanent grassland, or tillage management reducing the risk of soil erosion) would be covered by the new CAP regulations. At the same time restoration actions are likely to create employment and enhance incomes for farmers in the long run.

The benefit to cost analysis estimates that the total ecosystem service **benefits of restoration outweigh the costs by a ratio of 9:1**. The carbon sequestration benefits alone are estimated at 60-70 % of the overall costs.

An additional target on rewetting drained organic soils (drained peatlands) under agricultural use, would also generate considerable climate change mitigation and adaptation benefits, as well as significant benefits for biodiversity, water quality, flood risk mitigation, drought risk mitigation and socio-economic benefits from paludiculture and tourism. For example, rewetting drained agricultural soils can lead to decreases in emissions of around 20 tCO_2eq/ha/year. It is a cost-effective measure to reduce greenhouse gas emissions. The ratio between benefits, including biodiversity benefits and costs is expected to be considerably larger when also considering the other ecosystem services, including tourism and socio-economic benefits which are challenging to quantify.

Organic soils represent a significant proportion of arable land in some countries (e.g. Netherlands, Finland and Germany) where rewetting will consequently have a larger socio-economic impact, including a considerable opportunity cost. At the EU level however, agriculture on organic soil represents only around 1% of cropland and 4% of grassland (EU-15) meaning overall costs from lost productivity on these soils will be small relative to their climate and biodiversity benefits. Depending on the socioeconomic and ecological context of a given site, losses can be compensated through land purchase/acquisition, compensation schemes or by incentivising the establishment of alternative land uses such as paludiculture or extensive grazing.

In addition to the targets mentioned above, specific **indicators** can be used to provide evidence of enhancement of biodiversity: the grassland butterfly index, the share of agricultural land with landscape features, the organic carbon content in cropland mineral soils and the percentage of species and habitats of Community interest related to agriculture with stable or increasing trends. Increasing trends for this set of indicators would further provide overall important benefits to the environment, society and the economy.

Urban ecosystems *(see also Annex VI for a more detailed analysis)*

The proposed targets aim to end the current steady decline in the quality of urban ecosystems in cities and their commuter zones, that has been taking place over recent decades, and then to slowly reverse this trend and help to restore them. The targets address two fundamental indicators of urban ecosystem health: the total area of natural/green space, along with the sub-group comprising the total area of tree canopy cover, in 'Local Administrative Units' classified as 'cities' and as 'towns and suburbs', which together represent more than 20% of total EU land surface and represent more than 70% of the population. (i.e., the most densely populated areas)

For 2030, a target has been set to ensure, 'no-net loss' of 'urban green' including 'tree canopy cover' in all individual LAUs classified as 'cities' and 'towns and suburbs'. For 2050, the targets aim for an average 5 percentage point increase in the total area of green space (including tree canopy cover) averaged across these LAUs in each Member State (with an intermediate stop of a 3-percentage point increase by 2040), and that the minimum level of tree canopy cover in all individual LAUs reaches at least 10%.

The levels of targets proposed have been selected so as to be realistic, and achievable within the bounds of existing urban planning process. They are not only fully in line with EU and international objectives, but they will also do not need to be restricting for urban development, but rather help with steering it to be greener progressively over time. In relation to overall levels of urban green space, starting with 'no net-loss' but giving until 2030 to achieve this basic, common-sense, target will allow for some flexibility in approach. It should be borne in mind that urban development can be 'green' and can enhance the local environment if undertaken with due attention of urban ecosystem condition, such as by using, green roofs, permeable ‘green’ parking lots, focused tree/hedge planting and incorporation of biodiversity supporting features. Alternatively, or additionally, brownfield/abandoned sites can also be restored elsewhere in compensation. This impact assessment has shown there is potential for such land to significantly contribute to the targets proposed. Thus no-net loss of urban green is considered as a realistic and simple baseline for protecting, and later restoring, urban ecosystems. Having this target will provide a focus for urban planning process, steering them to help achieve the objectives of the biodiversity strategy.

The idea of the targets, and the levels to which they are set is to ensure that the amounts of green space and tree coverage become an integral part of the urban planning process, and that the reach good levels in terms of providing healthy urban ecosystems, by 2050. They can be achieved by restoring degraded and industrial land, greening new developments over time as they are built or replaced (i.e. industrial buildings, housing, retail, local authority builds including hospitals and schools) using options such as tree planting, (including tree-lining streets) green roofs, new green spaces, as well as other “multifunctional” green infrastructure, such as new green mobility lanes or by creation of new parks and woodlands in urban fringes.

In terms of the tree canopy cover targets these are considered as an important sub-set of urban green overall, (so the same arguments apply), but with a very high biodiversity and climate mitigation and adaptation value. It is vital that any urban greening targets ensure the provision, protection and increasing of tree canopy cover in EU urban ecosystems. There is significant capacity within all LAUs for the provision of some increase in tree canopy cover, so the aim of this target is to start moving in the right direction, in line with the planting of 3 billion trees commitment made under the Green Deal. The target for an absolute minimum of 10% tree canopy cover in the LAUs will help to ensure a minimum level of urban ecosystem restoration is undertaken, and support key climate change mitigation and adaptation objectives, in turn supporting air and water pollution objectives.

For 2050 achievable increases in the targets have been proposed that continue the restoration at a similar pace post 2030 and 2040, but over the following decades. Again, they have been set at a relatively low levels per year, to stimulate better urban planning processes, rather than to restrict growth / development.

Overall, there is good evidence related to the costs and benefits of increasing urban green space, albeit almost all in case study form. These demonstrate convincingly a wide range of positive benefits coming from increasing and maintaining higher levels of urban green space. Due to the wide variation, however, in many aspects of the studies, such as the (climate/locations/type of urban space), and the (often limited) parameters being investigated (pollution, energy, water runoff, health and well-being, climate mitigation etc) it is not possible to monetize some of these benefits in a generalized manner. Indeed, the high number of multiple co-benefits provided by using nature-based solutions to urban challenges tends to mean often the full benefits of urban green space and tree cover are underestimated. So, while it has not been possible to undertake a traditional cost/benefit analysis, as can be done on single issues, evidence points to the clear net positive values of halting the loss of, and then restoring green urban spaces.

Administrative impacts **(score: 2)**

The administrative costs for option 3 are estimated as the same as for option 2. However, to this is added a one-off cost of **EUR 6.56 million** for establishing an EU wide methodology (see detailed calculation in Annex VII). Similarly to option 2, the costs for 27 Member States together are estimated to amount to nearly **EUR 14 billion until 2050**. See Annex VII section 5 and Annex III for more details on administrative costs.

Administrative costs for option 3		
	One-off costs	***Annual costs***
Surveys of ecosystems	1 099 000 000	
Development of national restoration plans;	12 800 000	
Development of methodologies and indicators (5 ecosystems)	6 580 000	
Administration of restoration measures (2022-2030; 15 % target)		438 321 000
Monitoring of restored ecosystems		20 643 103
Reporting progress against restoration targets		107 000
Sub-total	***1 118 380 000***	***459 071 103***
Costs from 2022 to 2050	***1 118 380 000***	***12 853 990 884***
Total costs from 2022 to 2050		***13 972 370 884***

Given the large positive impacts of establishing common approaches and methods across the EU for ecosystems without defined indicators, and methods to define good condition, this represents particularly good value for money. It avoids the inefficiency costs if Member States would do it individually under option 2. It will further support efforts for more frequent and regular monitoring on the condition of ecosystems and biodiversity, in line with the requirements of the 8th Environmental Action Programme. Therefore, a more positive score is allocated for administrative impacts than in option 2.

The rate of restoration linked to Annex I habitats targets was also considered, i.e., either at the rate of 15 % by 2030, 40 % by 2040, and 100 % by 2050, or faster at the rate of 30 % by 2030, 60 % by 2040, and 100 % by 2050. An analysis is provided at the end of Annex VI and summarised below. This indicates that faster restoration pathway (30 %, 60 %, 100 %) provides better overall benefit to cost ratios, and a conclusion is that this version of the target should be used.

Overall, due to different levels of data availability, **different forms of benefit and cost estimates** were carried out for different ecosystem targets. For targets linked to wetlands, heathland and scrub, forests and rivers, numerical cost and benefits were calculated, and clear benefit/cost ratios were established, as shown in the table below.

For other ecosystems, a mixture of qualitative and quantitative estimates were used. For these too, positive benefit/cost ratios can be deduced. These are added to the table below to provide an overall summary, and indicating that **in all cases, the benefits are estimated to outweigh the costs.** However, the absence of aggregated monetary cost and benefit calculations for the assessments of four ecosystems should not be misinterpreted as meaning that target options assessed would stand out less positively in terms of their net benefit to reach the objectives.

Ecosystem type / Species	Benefit to cost ratio (With Annex I targets: 15 % by 2030, 40 % by 2040, 100 % by 2050)	Benefit to cost ratio (With Annex I targets: 30 % by 2030, 60 % by 2040, 100 % by 2050)
Inland wetlands (for peatland only)	7.1 (2.2 if carbon only)	8.3 (2.5 if carbon only)
Forests	4.1 (0.1 if for carbon only*)	4.1 (0.1 if for carbon only*)
Heathland and scrub	6.9 (1.3 if carbon only)	8.2 (1.5 if carbon only)
Agro-ecosystems	8.6 (0.6 if carbon only)	9.2 (0,7 if carbon only)
Rivers, lakes and alluvial habitats	24	26
Coastal wetlands	35.3 (0.2 if carbon only)	38.1 (0.2 if carbon only)
Median cost-benefit ratio between ecosystem types	7.9	8.8
Marine	Quantitative/Qualitative estimates indicate benefits very likely to outweigh the costs, in particular, in the longer term.	Quantitative/Qualitative estimates indicate benefits very likely to outweigh the costs, in particular, in the longer term.
Pollinators	Quantitative/Qualitative estimates indicate benefits very likely to outweigh the costs.	Quantitative/Qualitative estimates indicate benefits very likely to outweigh the costs.

In conclusion, for almost all the targets, the benefits outweigh the costs, and the approach also ensures that risks of delayed action are reduced as much as possible. Based on the above and the thematic summaries, the following scores are given: **4** for environmental impacts, **3** for socio-economic impacts and **2** for administrative impacts.

Robustness and limitations of the calculations: All cost and benefit calculations of ecosystem restoration are based on the best available evidence. The cost estimates are most robust for Annex I habitats, where we have more precise and reliable data (based on more experience and better data collection) than for other ecosystems. The approaches to estimating the costs and benefits of ecosystem services and their restoration are based on methods (both quantitative and qualitative) that have been developed extensively in the area of environmental economics. The IA has also been able to draw on evidence from a range of restoration programmes (for example under LIFE-nature), various specific studies, meta- and case-studies, as well a detailed study of the financing needs of meeting the restoration target of the EU Biodiversity Strategy to 2020. However, costs and benefits are to a large extent determined by local circumstances, which makes them more difficult to scale up in an exact manner. More details on the analytical methods are provided in Annex IV.

Risks that potentially limit the benefits of ecosystem restoration

There are a range of risks that the estimated benefits will not be realized, for instance if measures are not implemented as required; restoration actions fail to achieve the target condition because of scientific uncertainties, failure to undertake appropriate actions or adverse effects of climate, pollution, invasive species, conflicts etc. Even if ecosystems are restored to good condition, they may not deliver the anticipated benefits to people – e.g. because benefits occur in places remote from people and property. There is a risk of delay in achieving good ecosystem condition and of additional costs of restoration.

These risks can lead to a failure to meet the restoration targets, lower than foreseen benefits or/and costs that higher than anticipated. Accompanying measures such as incentives and guidance can mitigate these risks. The risks, their consequences and mitigation measures are listed in more detail in Annex IV.

Overall, these risks are significant, particularly because of the range of scientific uncertainties, locational variations and environmental factors that influence the effectiveness of ecosystem restoration and its benefits and costs. However, they can be mitigated through application and sharing of best available evidence; a robust approach to restoration planning; guidance, technical support and skills development; and monitoring and adaptive management. **The high benefit:cost ratios estimated for each ecosystem type, with benefit:cost ratios ranging from 4:1 to 38:1, leave a sufficient margin to ensure that ecosystem restoration will be efficient even if benefits are less than anticipated.**

Box 8: Views of stakeholders and authorities on the potential socio-economic impacts of ecosystem-specific targets.

*During the consultation exercise, a number of stakeholders stressed that **the restoration agenda should be a positive agenda** and the **multiple benefits** from ecosystem services to various stakeholders need to be made more visible. **State forestry representatives** emphasized that restoration needs to be integrated with rural economies. A representative of an environmental NGO stressed that ecosystem restoration is becoming a matter of survival, turning the tide on the nature crisis. Environmental NGOs saw restoration as a positive agenda for solutions, but noted that the benefits for various stakeholders should be made more visible: farmers, fishermen and foresters will be harmed if we do not act on climate change (through nature restoration).*

National authorities and stakeholders across the board called for an integrated strategy that considers ecosystem preservation as well as socio-economic development in urban and rural areas. Some national authorities underlined positive (voluntary) experiences with restoration, but also the complexity and cost of restoring ecosystems (such as peatlands).

***Forest owners and forestry sector stakeholders** expressed preference for a focus on restoration measures rather than on results. The need to ensure respect for **property rights** in the implementation of the targets at the national level was underlined, in relation to restoration on private land that needs prior and informed consent of the owner. They emphasized that, in order to bring forest managers and owners on board, proper consultation and support are needed including finance to compensate them for costs that bring broad benefits to society. Forestry sector stakeoholders further stressed the need to consider impacts **in the value chain**. The potential impacts of forest protection and restoration measures on the production of raw wood in the EU and potential relocation to third countries were also highlighted. Alignment with national forest acts' obligations on forest owners was also stressed.*

*Several stakeholders pointed to the need to be clear on **who would be responsible to implement** the targets and obligations. Two NGOs commented that the burden of implementation should be placed not only on the nature authorities, but also on other relevant administrations (e.g. water).*

*An environmental NGO in the Baltic Region pointed to likely impacts from restoration on fishermen, the recreational sector and other commercial sectors such as shipping, boating and energy production, for instance by displacement of their activities. New conflicts may arise with restoration when predators return and compete with human uses, making enemies from former allies (such as small fishers). Possible conflicts were also flagged with the objectives of the **Common Fisheries Policy**.*

How views of stakeholders and authorities have been taken into account:

The impact assessment highlights that the benefits far outweigh the costs of restoration. The proposal also emphasizes that Member States will need to involve stakeholders, including land owners (and users) in their National Restoration Plans. Member States will have the liberty to involve other departements than only the nature authorities in the implementation. The impact assessment report also addresses the issue of possible foregone incomes cause by restoration measures, by pointing out that they can already be compensated for totally or partially under EU funds such as the CAP, the EMFF, the Just Transition Fund and others, as well as under various national funds in most EU Member States.

6.4. Impacts of policy Option 4 (Ecosystem-specific targets and an overarching objective)

A combination of ecosystem-specific targets and an overarching objective would overcome some of the weaknesses of the previous two options. An overarching objective would provide impetus and clarity of overall ambition. As such, it has an important added performance value for communication, as a political driver at EU-level, in the Member States as well in international context, and for mainstreaming purposes. It would raise public awareness and a common agenda for action that can appeal to a broad group of stakeholders. In this way the headline objective would be more likely to have an impact in mainstream politics, rather than risk remaining in the domain of environmental administrators. Lastly, since the overarching objective addresses most ecosystems, this further underlines the need to complement the targets in step 1 with further targets in step 2.

Making this an overarching objective in the law, and coupling it with ecosystem specific targets of option 3, would avoid the difficulties in enforceability described under option 2. The ecosystem-specific targets can help make sure there will be a measurable delivery on biodiversity, by making the restoration objectives concrete, measurable and enforceable, and help ensure that all ecosystems/habitats that require restoration will be addressed. Evidence in the implementation of nature policy has shown that more targeted approaches in terms of specific biodiversity objectives, measures and tracking can greatly improve effectiveness and the achievement of objectives. The specificity of a number of ecosystem specific targets, coupled with an overarching objective makes this option a very effective one.

Effectiveness (average score: 3.6)

In terms of effectiveness the analysis is virtually the same as option 3. However, the addition of the overarching objective makes the ecosystem-specific targets even more **achievable**. It namely has an important added performance value for communication, political and mainstreaming purposes. First, it expresses the common ambition across Member States and stakeholders, thereby bringing the different specific target options under one umbrella and driving overall direction. Second, it makes clear that the legislation intends to go beyond only restoring those ecosystems for which targets are set in step 1. This would strengthen the requirement for Member States to already consider restoring ecosystems for which targets may only be set in step 2. Third, it provides a clear link to the vision of the Biodiversity Strategy for 2030[1], as well as the global vision under the Convention on Biological Diversity. In sum, the various aspects of this option, complemented by the advantages of an overarching objective, makes it feasible to attain the policy objectives, and is therefore considered very effective.

Policy option 4: effectiveness	**Score**
Timing	3
Specificity	4
Measurability	3
Achievability	4
Coordinated action	4
Comprehensiveness	4
Enabling measures	3
Total	*25*
Average	*3.6*
Assessment	*Very effective*

Policy coherence (score: 3)

Option 4 has at least the same level of coherence as option 3, but with the addition of an overarching goal, bringing it more in line with the ambition level of the Green Deal.

Efficiency (average score: 3)

For option 4 environmental and social impacts are likely to be higher than in option 3, however the differences in scoring level is not fine grained enough to represent these differences (scores are however different for effectiveness). Administrative impacts are likely to be the same. As such, it receives the same scores as option 3 i.e.: **4** for environmental impacts, **3** for socio-economic impacts and **2** for administrative impacts.

Estimates of total costs for Option 4 *(see Annex III, VI and XII for more details)*

The total **restoration and maintenance costs** for peatlands, marshlands, forests, heathland and scrub, grasslands (including pollinators), rivers, lakes and alluvial habitats, and coastal wetlands can be estimated at around **EUR 140 billion** under the scenario of 30-60-100% targets for 2030-2040-2050 for HD Annex I. This includes foregone income as an opportunity cost resulting from restoration by businesses such as farmers. However, restoration and maintenance costs for marine and urban ecosystems as well as pollinators are not included due to uncertainties and data gaps, although it is likely that pollinators will benefit from actions taken (and associated costs) to restore terrestrial ecosystems such as grasslands.

Besides restoration and maintenance costs, there are costs foreseen for enabling measures (**administrative costs**) such as establishing methodologies and indicators, developing National Restoration Plans and monitoring progress. These costs are exactly the same as for option 3, including an estimated one-off cost of about EUR 1.1 billion and annual costs of about EUR 459 million (or a total annual costs of EUR 13 billion counting from 2022 to 2050), leading to a total cost for enabling measures of about **EUR 14 billion**.

The total costs for this policy option are therefore estimated to be at least **EUR 154 billion** (140 + 14) up to 2070[124], not including restoration and maintenance costs for marine and urban ecosystems as well as pollinators.

Overview of costs for the preferred option – until 2070 (present values)				
Action	**One-off costs in EUR million**	**Annual costs in EUR million**	**Total in EUR million for scenario A (15-40-100% targets by 2030-2040-2050)**	**Total in EUR million for scenario B (30-60-100% targets by 2030-2040-2050) Comments**
Costs for restoration and maintenance per ecosystem type for both Member States and businesses				
Peatlands			4 779	5 125
Marshlands			3 643	3 721
Coastal wetlands			5 141	5 852
Forests			50 082	53 850
Agro-ecosystems			26 559	27 732
Steppe, heath and scrub			3 051	3 111
Rivers, lakes and alluvial habitats			35 232	40 211
Sub-total			***128 487***	***139 602***
Marine, urban, pollinators			(na)	(na)
Costs for enabling measures for Member States				
Surveys of ecosystems	1 099			
Development of national restoration plans	12.8			
Development of methodologies and indicators (5 ecosystems)	6.6			

[124] Costs until 2070 are given in line with the benefits. It takes into account that for restoration measures undertaken up to 2050, especially in the final years, the benefits would only be visible beyond 2050. All cost 'actions' are foreseen to be undertaken up to 2050, except for maintenance costs, which extend to 2070.

Overview of costs for the preferred option – until 2070 (present values)				
Action	**One-off costs in EUR million**	**Annual costs in EUR million**	**Total in EUR million for scenario A (15-40-100% targets by 2030-2040-2050)**	**Total in EUR million for scenario B (30-60-100% targets by 2030-2040-2050) Comments**
Administration of restoration measures		438.3		
Monitoring of restored ecosystems		20.6		
Reporting progress against restoration targets		0.1		
Sub-total	***1 118.4***	***459***		
Costs from 2022 to 2050	***1 118.4***	***12 854***	***13 972.4***	***13 972.4***
Total costs: restoration, maintenance and enabling measures				
Total			***142 459.4***	***153 574.4***

While these figures provide order of magnitude estimates only, as described in Annex XII there is a variety of sources of funding available to finance these costs for restoration, maintenance, compensation and enabling measures. The short-term possible costs linked with lost incomes that certain population groups such as to farmers, forest owners or fishers, may incur while they transition to more sustainable practices could be partially or totally covered under EU and other sources funding. Member States would also need to consider the social implications. As described in more detail in Annex XII, and **based on order of magnitude estimates, there should be sufficient funding available to cover these costs in the period up to 2050.** Specifically, the estimated EUR 14 billion annual biodiversity spending under the MFF (2021-2027) could cover to a large extent the annual total costs of restoration of EUR 6-8 billion. For instance, the CAP will be an important source of funding of restoration measures and support to farmers faced with transitioning costs. This could be further complemented with other sources of national and public-private and business sources of financing. However, the details will depend on the NRPs of the Member States on how exactly financing will be channelled towards ecosystem restoration. At the same time, it can be expected that legally binding targets will significantly contribute to stimulating such further financing. Member States may also need to consider and address shortages in labour and skills needed to implement the restoration measures, e.g. through training programmes such as the European Solidarity Corps.

Estimates of total benefits for Option 4 *(see Annex III, VI and XII for more details)*

The total **benefits** for peatlands, marshlands, forests, heathland and scrub, grasslands (including pollinators), rivers, lakes and alluvial habitats, and coastal wetlands can be estimated at around **EUR 1 860 billion** under the scenario of 30-60-100% targets for 2030-2040-2050 for HD Annex I. This is 12 times more than the estimated costs. The benefits include carbon removal and storage and many other ecosystem services. Benefits resulting from the restoration of marine and urban ecosystems as well as pollinators are not included due to uncertainties and data gaps. More background and detail on these data are provided in Annex III and VI.

Overview of benefits for the preferred option – until 2070[125] (Present Value)					
	Scenario A (15-40-100% targets for 2030-2040-2050)			**Scenario B (30-60-100% targets for 2030-2040-2050)**	
Restoration of ecosystem type/species	**Carbon benefits in EUR million**	**Benefits from all ecosystem services (including carbon) in EUR million**		**Carbon benefits in EUR million**	**Benefits from all ecosystem services (including carbon) in EUR million**
Peatlands	10 629	38 702		13 042	47 488
Marshlands	(na)	6 388		(na)	7 838
Coastal wetlands	1 091	181 614		1 339	222 842
Forests	3 832	203 564		4 701	249 775
Agro-ecosystems	17 073	229 589		18 624	250 451
Steppe, heath and scrub	3 971	24 191		4 722	28 768
Rivers, lakes and alluvial habitats	(na)	862 349		(na)	1 053 042
Sub-total	***36 596***	***1 546 397***		***42 428***	***1 860 204***
Marine	(na)	(na)		(na)	(na)
Urban	(na)	(na)		(na)	(na)
Pollinators	(na)	(na)		(na)	(na)

Although in theory the EU should aim to restore all degraded ecosystems by 2050, and targets should align with this goal, **in practice complete implementation is unlikely to be achievable.** Some sites may be inaccessible, face insurmountable technical barriers to restoration, be adversely affected by external pressures such as pollution, be earmarked for changes in land use, or be subject to disputes between land owners, managers and the authorities. The analysis for the impact assessment assumed that **restoring 90% of degraded ecosystems could be regarded as a realistic level of full implementation.** The benefit: cost analyses are therefore based on a 90% restoration target by 2050.

A failure to restore 90% of the area of degraded ecosystems by 2050 would reduce both the benefits and costs of ecosystem restoration. In Annex IV, estimates are presented on the value of the benefits and costs of restoration of different ecosystem types, for scenarios

[125] Benefits until 2070 are given to take into account the benefits from restoration measures undertaken up to 2050, especially in the final years, of which benefits would only be visible beyond 2050.

in which lower (70% or 80%) rates of restoration are achieved. **This shows that, if full implementation is not achieved, there is a reduction in costs as well as benefits, such that benefit:cost ratios still remains favourable by far**.

Impacts on areas surrounded by ecosystems in which restoration measures are taken

Restoration can have an impact on surrounding areas. For instance, the rewetting of inland wetlands could cause indirect opportunity costs for agriculture in some areas, especially in small wetland sites surrounded by intensive agriculture where mitigation measures to avoid seepage are not in place. However, they represent only a small share of the total area of inland wetland ecosystem considered in the assessment. As such 'external' negative impacts of measures would likely be relatively limited, their inclusion in the cost-benefit analysis would probably not have made a significant difference on the overall cost estimate. Therefore, the assessment did not quantify such indirect costs of restoration.

The impacts would be similar as those assessed for inland Annex I habitats and would require different management practices by private landowners and land managers, in return for incentive payments which include compensation for opportunity costs relating directly to land management (e.g. income forgone through reduced yield or grazing). As explained in Annex III, such practices and incentive schemes are in place, as well as public budgets to support their increased uptake.

Considering the large positive benefit to cost ratios of nature restoration across the different ecosystem types, even if external costs excluded would nonetheless significant, they would likely still be (far) outweighed by larger benefits and would not have changed the overall findings of the assessment. Inland wetland rewetting for example could also have positive impacts on water availability for agriculture during droughts likely to increase with climate change in most regions.

Distribution of benefits and costs between EU Member States

As set out in Annex III (Table III-3), the distribution of estimated costs and benefits differs between EU Member States. The two main defining cost variables are 1) the extent of ecosystem in the Member States and 2) its condition, i.e. the share of extent which is degraded and will require restoration measures[126]. As a result the Member States with larger degraded Annex I habitats face the largest effort: The largest absolute costs are incurred in France (EUR 2.1 billion), Spain (EUR 1.5 billion) and Finland (EUR 0.9 billion). Some Member States have relatively large areas of several ecosystems, but also record a relatively small proportion to be in not-good condition, such that costs of

[126] In the case of the Phase 1 targets, ecosystem extent is mainly represented by HD Annex I habitat, and its condition its area reported as being in not-good status. See Annex IV ('Analytical methods') and Annex VII ('Background information for potential restoration targets') for method and Annex I extent and condition information respectively.

restoration and maintenance are relatively low compared to ecosystem area (e.g. Austria, Germany, Greece, Italy, Sweden).

Member States face differentiated costs for different ecosystems too. For example, the largest costs for each ecosystem are, in order of magnitude, as follows:

- Coastal wetlands - Denmark, the Netherlands, France and Germany;
- Fresh waters – France and Finland;
- Forests – France and Spain;
- Grasslands – Spain and France;
- Heath, steppe and scrub – Spain and Finland;
- Peatlands – Finland and Sweden.

Despite these variations, when looking at the overall picture, costs and benefits are reasonably equally spread between EU Member States. Annual costs expressed as share of GDP range from 0.01% of GDP in the case of Belgium, Germany, the Netherlands and Luxembourg to 0.39% in the case of Finland, but most Member States are closer to the average of 0.06% for the EU (median 0.08%). Benefits expressed as share of GDP range from 0.02% in Malta to an exceptional 4.11% in Finland, with average benefits representing 0.48% on average (median 0.58%). Annual costs per MS citizen range from less than EUR 1 Euro in Malta (against EUR 4 benefits) to more than EUR 168 in Finland (against over EUR 1750 benefit), but average annual costs per EU citizen are less than EUR 17 and benefits EUR 144 (median EUR 14 and EUR 117 respectively). The table below provides a full overview of annual benefits and costs as share of GDP and per citizen.

Overview of annual costs and benefits as share of GDP (Eurostat, 2020) and per citizen (Eurostat, 2021)

Member State	Benefits (million €)	Costs (million €)	Benefits/ GDP	Costs/ GDP	Benefit/ Citizen (€)	Cost/ Citizen (€)
AT	774	65	0,20%	0,02%	87	7
BE	631	65	0,14%	0,01%	55	6
BG	630	69	1,03%	0,11%	91	10
CY	38	7	0,18%	0,03%	42	8
CZ	361	41	0,17%	0,02%	34	4
DE	2.595	190	0,08%	0,01%	31	2
DK	3.171	176	1,01%	0,06%	543	30
EE	449	38	1,67%	0,14%	338	29
ES	7.939	1.451	0,71%	0,13%	168	31
FI	9.694	931	4,11%	0,39%	1.752	168

FR	14.618	2.060	0,63%	0,09%	217	31
GR	541	34	0,33%	0,02%	51	3
HR	622	63	1,24%	0,13%	154	16
HU	1.392	133	1,02%	0,10%	143	14
IE	1.922	134	0,52%	0,04%	384	27
IT	2.424	261	0,15%	0,02%	41	4
LT	1.081	80	2,18%	0,16%	571	42
LU	32	5	0,05%	0,01%	50	7
LV	611	54	2,07%	0,18%	323	29
MT	2	0	0,02%	0,00%	4	1
NL	1.056	53	0,13%	0,01%	60	3
PL	5.981	545	1,14%	0,10%	158	14
PT	915	149	0,46%	0,07%	89	14
RO	-	-	-	-	-	-
SE	5.881	638	1,24%	0,13%	567	61
SI	415	63	0,88%	0,13%	197	30
SK	473	98	0,51%	0,11%	87	18
TOTAL	**64.248**	**7.405**				
AVERAGE			0,48%	0,06%	**144**	**17**
MEDIAN			0,58%	0,08%	**117**	**14**

Transboundary Issues

Ecosystems and their species are transboundary by nature, and on the whole the restoration objective and targets will have positive effects for nature across the EU. For areas near or at the borders, cooperation and joint management on both sides can be encouraged through promotion of sharing good practices and building synergies (for example such as Interreg funds that have helped in many cases). Cooperation across borders beyond the EU may also be addressed in a similar manner. These might be most successful in areas where transboundary collaboration is already established (such as for example following from implementation of existing legislation) and collaborative structures are in place. For some ecosystems (e.g. rivers, ecosystems spanning borders) transbordery cooperation may be more relevant than for others.

A focus on specific, near or at border areas can be addressed as part of the National Restoration Plans – Member States could foster synergies with the national restoration plans of other Member States – as well as by identifying appropriate sources of funding. The development of the EU wide methodology can also help when developing definitions of good condition so as to ensure that ecosystems would have consistent criteria and indicators across borders. Furthermore, transboundary activities can also be supported by the definition of restoration measures: i.e.: restoration measures include measures taken for the improvement of the condition of an ecosystem, for the re-establishment of an ecosystem where it was lost as well as measures to improve connectivity of ecosystems, including across national borders.

Impacts on the rights to equality and non-discrimination

The options will aim to address various sources of risks to the right to non-discrimination and require that possible sources of biases embedded in the national restoration plans should be properly addressed and mitigated. Restoration measures set out in national restoration plans may not be used to discriminate between different groups in society, and all groups in society will be entitled to equally reap the benefits of restoration, including in terms of employment opportunities. Transparency obligations during the preparation of national restoration plans as well as specific provisions on access to justice, including for vulnerable and marginalized groups, will minimize the risk of discrimination and mitigate inequalities. Based on previous examples of equality mainstreaming in environmental policy at EU level, the issue is not expected to be prominent.

Impacts on food security

Recent geo-political developments have underlined the need to safeguard food security and the resilience of food systems. A review of scientific evidence shows that ecosystem restoration and sustainable farming practices have a positive impact on food productivity and resilience[127]. For example:

- Natural insects' pollination is known to maintain or enhance yields, food quality and economic returns to farmers. It has been estimated that a collapse in pollinators could cause a global drop in GDP of 1-2%, due to reduced agricultural production. The full implications of the collapse for human welfare have yet to be estimated, but they would reach far beyond the mere damages in crop yields. Scientific evidence shows a great potential of **nature restoration measures to support pollinators** by providing them habitat with high quality food, nesting and overwintering resources or by reducing their exposure to pesticides.

[127] Liquete C. et al., *JRC Science for Policy Report: Review of scientific evidence showing the impacts of nature restoration actions on food productivity*, to be published soon.

- Inclusion of **landscape features in farms**, increasing landscape complexity: there is evidence of positive effects on pest control (in particular around arable land) and pollination (emphasized by floral abundance), with a 1.4-fold increase in pest control and the 1.7-fold increase in pollination observed in landscapes with high edge density. In some cases, these positive effects can translate into higher yields.
- **No-tillage** leads to a significant restoration of soil quality, even more acute if this is combined with organic fertilisation. When no-tillage is combined with cover crops, it can maintain or even increase crop yield and reduce costs while enhancing soil fertility.
- A **combination of various sustainable agricultural practices** multiply their positive effects on the environment and on food productivity. **Agroecology**, the most integrative approach to farming, food and socio-economic systems, seem to produce the best results. Several meta-analyses and reviews conclude that agroecological practices have positive outcomes on food security through higher yields, improved nutritional content and stronger resilience and stability against climate and socio-economic disturbances.
- **Restoration of marine ecosystem** through protection of certain areas: around 80% of properly enforced marine protected areas have been observed to have a positive spillover effect in the surrounding fisheries, and this effect can increase gradually over decades. The spillover effect is of major importance around no-take zones, with examples of catches raised 5-fold in only four years time and beneficial side effects in fishers' income, tourism, social wellbeing and the regeneration of distant fisheries.

7. HOW DO THE OPTIONS COMPARE?

This chapter first provides a summarised comparison of the policy options based on the assessment of effectiveness, policy coherence and efficiency in Chapter 6. It is followed by a comparison in terms of, subsidiarity and proportionality. Based on the criteria for effectiveness, policy coherence and efficiency the preferred option can be selected.

Effectiveness

Options 3 and 4 score very positively for **specificity**, **coordinated action** and **comprehensiveness** because they include specific targets over a broad range of ecosystems and species, whereas this is not the case for options 1 and 2. For **timing,** options 2, 3 and 4 score positively because targets are clearly time-bound. In terms of **measurability**, only options 3 and 4 score positively because the targets mainly build on the monitoring mechanisms of the BHD and because they would entail establishing an EU-wide methodology for determining condition and monitoring framework for ecosystems and species not covered under existing legislation. The 2030 and 2050 timeframes for restoration are realistic. Moreover, the targets contain both aspects of "restoration" and "recovery of good condition" and are both legally verifiable. Options 3 and 4 score high with **enabling measures** since the overall implementation framework of NRPs, and periodic review and assessment ensure implementation regime to 2050, furthermore the EU wide methodology provides significant added value. Option 4 is expected to be more effective than option 3 for **achievability**, since the addition of the overarching objective explicitly in the legal text makes the ecosystem-specific targets even more **achievable** (rather than the overarching objective itself which, again, is only aspirational); it namely has an important added performance value for communication, political orientation and ambition, and mainstreaming purposes. Even though the Biodiversity Strategy to 2030 has an overarching aspirational objective, the difference here is that the inclusion of this objective in the legal text as a clear overarching objective makes a significant difference in the terms of legal obligations: in that all Member State have the obligation to strive towards this objective. In sum, option 4 is expected to be the most effective to achieve the specific objectives.

Effectiveness	**Policy option 1**	**Policy option 2**	**Policy option 3**	**Policy option 4**
Timing	0	3	3	3
Specificity	0	0	4	4
Measurability	0	1	3	3
Achievability	0	1	3	4
Coordinated action	0	3	4	4
Comprehensiveness	0	2	4	4
Enabling measures	0	2	3	3
Total	*0*	*12*	*24*	*25*
Average	*0*	*1.7*	*3.4*	*3.6*
Assessment	*Neutral/baseline*	*Moderately effective*	*Effective*	*Very effective*

Policy coherence

Option 1 is assessed as the least coherent because, even though it is coherent with elements in the BDS2030, there is no additional stimulus to actively promote synergies with them. Option 2 would be slightly coherent because it provides a legally binding time-bound goal that strengthens existing restoration requirements under the BHD, WFD and MSFD but is not explicit in the specific interrelationship. Options 3 and 4 are assessed as coherent because synergies are foreseen between the ecosystem-specific targets and aspects such as monitoring and legal obligations under existing and upcoming legislation, including for climate, thereby also accelerating implementation.

Policy coherence	**Policy option 1**	**Policy option 2**	**Policy option 3**	**Policy option 4**
Score	0	1	3	3
Assessment	*Neutral/baseline*	*Slighty coherent*	*Coherent*	*Coherent*

Efficiency

Options 3 and 4 are the most efficient options because, overall, the environmental and socio-economic benefits will outweigh the administrative and socio-economic costs. While both options 3 and 4 are scored equally efficient, option 4 is expected to have slightly higher environmental and socio-economic benefits as a result of the overarching objective, however, this benefit is too small to show in the range of numbers used in the scoring system. Option 2 is only moderately efficient mostly because it is expected to yield notably lower environmental benefits. Because of this it is expected that the amount of ecosystem services supplied to the benefit of the economy and society is lower as well, resulting in a lower score for socio-economic impacts. Administrative costs for option 3 and 4 would be the same, amounting to about EUR 14 billion to 2050.

It should also be noted that the more we delay restoration, the higher the administrative and socio-economic costs will be in the future. One must also avoid the potential of irreversible damage. These investments are necessary in order to prevent significantly larger costs in the future.

Efficiency	**Policy option 1**	**Policy option 2**	**Policy option 3**	**Policy option 4**
Environmental impacts	0	2	4	4
Socio-economic impacts	0	2	3	3
Administrative impacts	0	1	2	2
Total score	*0*	*5*	*9*	*9*
Average score	*0*	*1.7*	*3*	*3*
Assessment	*Neutral/baseline*	*Moderately efficient*	*Efficient*	*Efficient*

Subsidiarity and proportionality

Subsidiarity

The legal basis for this legal proposal, Article 192(1) of the Treaty on the Functioning of the European Union, as outlined in section 3.1, states that “Union policy on the environment shall contribute to pursuit of […] preserving, protecting and improving the quality of the environment”. EU competence thus encompasses the entire environment including all ecosystem types. Many environmental issues occur and have impacts at a large geographical scale. See also section 3.2 and 3.3. At the same time, restoration is an activity that in practice is carried out at a national, regional or local level. It can strongly depend on specific characteristics at the national, regional, or local level, such as biogeographical regions, specific regional, or local, biotic or abiotic features. Restoration thus lends itself naturally to an approach that needs to account for local, regional, and national specificities, whilst maintaining an overall large-scale perspective and direction. This provides the context to consider how to balance effectively what should be best carried out at EU level with what should be best carried out at Member Sates level.

In option 1 there is no new EU level requirement to attribute between EU and MS responsibilities, thus the neutral score is attributed. For option 2, quite a large degree of discretion is left to member States on how to reach the EU overarching target. This option attributes a large degree of responsibility to Member State level.

Options 3 and 4 attribute ecosystem specific targets to Member States and Member States develop National Restoration Plans on how to reach them. These plans will thus enable the planning and execution of restoration according to their national situation.

Options 2, 3 and 4 attribute responsibilities at EU or Member State level in an effective manner, since there is an appropriate balance between the EU level objective and responsibilities at Member State level.

Subsidiarity is assessed as moderately positive for option 2. It leaves the most flexibility to Member States to determine how they would achieve the overarching target set by the EU. However, the objectives cannot be sufficiently achieved by leaving so much to the Member States in a way that is not specific enough, and more specification at EU level is needed. Options 3 and 4 require Member States to restore certain percentages of their ecosystems within certain timeframes, thus leaving less room for discretion by Member States. However, in their National Restoration Plans, Member States still get considerable discretion to choose what areas, measures and financing mechanisms to employ at national, regional or local level as needed; this leads to a positive score. Each option could also entail further EU level guidance as needed, as has been the case for existing relevant environmental Directives.

Furthermore, for some ecosystems such as forest or urban, for which legislation at EU level is partial and patchy, little or no action has been carried out by Member States, often in a way that is inconsistent with EU policies, undermining the possibility to achieve the related EU objectives. An EU framework on restoration targets would help coherent action at national level, with standards and comparable definitions, monitoring and reporting on progress. This would bring synergies and more effective joint action at EU and national level.

Proportionality

Following from Article 5 of the TFEU: the content and form of proposed option should not exceed what is necessary to achieve the objectives. This is used as the basis to analyse the proportionality of the options.

For **Option 1,** this does not apply, since baseline does not establish new action, therefore a neutral score is given. **Option 2** is only moderately proportionate. It leaves a large degree of scope for national decision making, since it is up to Member States to determine how to reach the overarching target through the development of NRPs. The problem is that it leaves too much undefined in terms of specific restoration requirements in order to be able to reach the objective. Technically speaking it does not exceed what is necessary, but rather significantly falls short of what is needed to achieve the objective. **Option 3** is proportionate. Even though this option introduces a number of ecosystem-specific restoration targets, and thus adds content and substance to the proposal, this is necessary to ensure that the objective can be achieved. Furthermore, the 2-step approach is specifically designed not to exceed what is needed, since it builds on existing reporting and monitoring structures whenever possible and appropriate. It sets up new data gathering processes and monitoring requirements only for those ecosystems or habitats where information is not available and needs to be developed. In addition, the EU-wide methodology means that a common and streamlined approach can be developed, leading to efficiency gains. In summary, to be able to address the broad range of ecosystems across the EU, certain additional responsibilities and corresponding costs are necessary and cannot be avoided but can be streamlined based on efficient and common approaches.

Option 4 adds to the advantages of option 3 by including the overarching goal as a clear overall legal obligation that Member States together must strive towards. It also clearly articulates the overall political drive and ambition of the law. Together this further ensures the achievability of the objective. This additional requirement does further ensure the achievability of attaining the objectives in an effective manner, without adding burden to the implementation of the proposal, since the overarching objective sets the orientation and ambition of the law, and obliges Member States to strive towards this objective. There is no specific reporting obligation associated with this objective as such. Progress towards it will be based on the reporting for other ecosystem-specific restoration targets and obligations. Based on this Member States' reporting, the Commission can assess the total areas subject to restoration measures in each Member State and, summed up to the EU-level, progress towards the overarching objective. The enforceability will relate to the ecosystem-specific restoration targets and obligations rather than the overarching objective. This overarching objective will be considered by the Commission in its assessment of the National Restoration Plans. In summary, option 4 sets an overarching goal and ecosystem-specific targets in a way that is commensurate to scale and extent of the objectives to be achieved, and provides assurance that these objectives can be reached. As such it is very proportionate to attain the objectives.

Subsidiarity and proportionality	**Policy option 1**	**Policy option 2**	**Policy option 3**	**Policy option 4**
Assessment for subsidiarity	*Neutral/baseline*	*Moderately positive*	*Positive*	*Positive*
Assessment for proportionality	*Neutral/baseline*	*Moderately positive*	*Positive*	*Very positive*

Overall comparison

Based on the comparison of policy options in terms of effectiveness, efficiency and policy coherence, both options 3 and 4 are clearly the most favourable. Of these, option 4 performs slightly better in terms of effectiveness because having an overarching objective makes the specific targets more achievable. Subsidiarity and proportionality are presented in the table below to give an overview but are not used in the calculation of the overall average, as they are additional qualitative considerations.

From a risk perspective, the **risks of not acting at all** are illustrated by the potential outcomes of the baseline scenario. These risks are progressively turned into opportunities as we step up through the options, with option 4 performing the best in reaching the objectives. Within this option, the two-step approach also reduces the **risks of delaying action** across all of the ecosystem types by acting where it is possible now. This reduces potentially postponed action, increasing negative impacts on the environment, economy and society; and at the same time ensures broad coverage by developing measurement and monitoring methodologies for remaining areas.

The main costs of inaction can be taken to be the same as the lost benefits of action. Lack of action on legally binding targets is equivalent to the baseline. Thus, the long-term costs of inaction can be estimated as the foregone benefits minus the foregone costs, for restoring peatlands, marshlands, forests, heathland and scrub, grasslands (including pollinators), rivers, lakes and alluvial habitats, and coastal wetlands. Thus, the main **costs of inaction correspond to the order of EUR 1 700 billion** (net present value of forgone benefits; roughly 1 860 billion benefits of action, minus EUR 154 billion costs of action). Further costs of inaction would be expected for marine, urban, and for pollinator restoration. It should be noted that these are minimum estimates, since one would also have to add the costs of acting late. Acting late is of particular importance to restoring ecosystems, since restoring an ecosystem that is heavily degraded will costs more than restoring the same ecosystem in a less degraded state.

Overall comparison	**Policy option 1**	**Policy option 2**	**Policy option 3**	**Policy option 4**
Average score for effectiveness	0	2	3.4	3.6
Average score for efficiency	0	1.7	*3*	*3*
Score for policy coherence	0	1	3	3
Overall total score	*0*	*4.7*	*9.4*	*9.6*
Overall average score	***0***	***1.6***	***3.1***	***3.2***
Overall assessment	***Neutral/baseline***	***Moderately positive***	***Positive***	***Positive***
Assessment for subsidiarity	*Neutral/baseline*	*Moderately positive*	*Positive*	*Positive*
Assessment for proportionality	*Neutral/baseline*	*Moderately positive*	*Positive*	*Very positive*

8. PREFERRED OPTION

Option 4 is the preferred option.

The preferred option proposes a nature restoration law that will establish an **overarching objective** ‘to contribute to the continuous, long term and sustained recovery of biodiverse and resilient nature across EU land and sea areas through the restoration of ecosystems and to contribute to the EU's overarching objectives concerning climate change mitigation and adaptation, and to contribute to meeting the EU's international commitments; and that the restoration measures together shall cover, by 2030, at least 20 % of the Union's land and sea areas and, by 2050, all ecosystems in need of restoration'. To support achieving this objective, **the law will establish a number of ecosystem-specific binding targets across a broad range of ecosystems, coupled with an effective implementation framework**. This preferred option for the law will ensure that the objectives of ecosystem restoration can be reached in the timescales proposed in a cost-efficient manner, **with benefits outweighing the costs for each of the main ecosystem type**. The benefits of restoring peatlands, marshlands, forests, heathland and scrub, grasslands (including pollinators), rivers, lakes and alluvial habitats, and coastal wetlands can be estimated as of the order of **EUR 1 860 billion,** with costs estimated at EUR 154 billion**.** The administrative costs are estimated as of the order of EUR 14 billion and would by incurred mainly by Member State authorities. Costs for citizes and businesses are expected to be low and depend on the implementation approach taken by each individual Member State in its National Restoration Plan. Transitioning costs for impacted businesses (mainly farmers, foresters, fishers) could be compensated for through several funding sources. Significant benefits are also estimated the for the ecosystem types, marine, urban, and for pollinator restoration. The risks of not acting, or not acting with sufficient urgency, have also been analysed and estimated as of the order of **EUR 1 700 billion** (Chapter 6).

The law will work in synergy with and add value to the existing acquis: the Birds and Habitats Directives (BHD), the Water Framework Directive (WFD) and the Marine Strategy Directive (MSFD) and will also support the acceleration of the implementation of these directives. It will complement the BHD coverage with time bound targets and by requiring restoration action across the territory of the Member States (including outside Natura 2000) and cover aspects which go beyond the direct scope of the application of the MFSD and the WFD. Significant contributions to climate policies will be established following from carbon removal, storage and disaster risk reduction services of the restored ecosystems. Synergies with several related policies and initiatives such as the soil and forest strategies, LULUCF, CAP, CFP, and others will be ensured. For instance, the CAP will play an important role in supporting restoration measures and compensating transitioning costs for farmers and foresters (see Annex XII). In synergy with the Common Fisheries Policy, the national restoration plans could include the conservation measures a Member State intends to adopt under the CFP. And the proposed revised LULUCF Regulation includes provisions concerning monitoring systems for land-use units subject to restoration. This more integrated approach will ensure that measures on climate mitigation and nature restoration will now be mutually reinforcing. Overall, the nature restoration law will provide important contributions to the implementation of the Green Deal (Annex X).

Implementation will be carried out via the **National Restoration Plans** that Member States will develop to achieve the targets. Member States will report on progress achieved at national level against the benchmarks set. The Commission will evaluate the plans before their adoption and **check on progress on a periodic basis**, including by using data and monitoring gathered and analysed by the European Environment Agency. Additional specifications or guidelines to the law would be developed as needed (Chapter 5.2).

Overall **cost estimates of the preferred option can be made**, based on numerical estimates for several ecosystems for which data is available. Several funding sources at EU and Member States level can be harnessed to cover these costs, as well as business commitments and private sector engagement. An overall balance of restoration costs and other costs can in principle be met through a number of sources at EU level, at Member States level and through public/private financing (Annex XII).

A fair and cross-society approach will be established that will involve citizens and stakeholders in decision making and restoration activities and assist those potentially affected by change through some of the funding sources identified (Chapter 5.2/Annex III). Member states may need to address potential labour and skill shortages that could prevent delivering on this initiative.

The preferred option will in a first step **restore significant areas of the EU**, with measurable results by 2030, 2040 and 2050. Further, it will ensure an even broader coverage in the future, with targets that can be established in the second step for a broader range of ecosystems such as agro-ecosystems and forests based on an EU wide methodology as set out in the legislation.

The preferred option thus **allows to EU to act with urgency** and start restoring ecosystems based on targets that can be measured and monitored already now. This will ensure that a range of restoration actions can start quickly across Member States. By establishing targets for a further range of ecosystems or species **at later stages, it ensures comprehensive coverage of the EU's ecosystems.**

The preferred option thus paves the way for a broad range of ecosystems in the EU to be restored and maintained by 2050, with measurable results by 2030. It will act as a major enabler at EU level contributing to halting biodiversity loss and bringing nature back to good health and will also give the EU the necessary credibility to lead on the global scene on nature.

International dimension

The overarching objective and the more specific targets will help the EU to deliver on its international commitments, in particular in the context of the post-2020 Global Biodiversity Framework and the UN decade for ecosystem restoration. In addition to setting the example and developing methodologies that can be used elsewhere in the world, achieving these objectives in the EU (including outer-most regions) constitutes an important part of delivering on the headline ambition in the Biodiversity Strategy for 2030 "to ensure that by 2050 all of the world's ecosystems are restored, resilient, and adequately protected". Furthermore, the EU has committed to supporting restoration efforts in other parts of the world, such as the Great Green Wall initiative for the Sahara and the Sahel, as well as support biodiversity, forests and other ecosystems' conservation, restoration and sustainable use efforts in many partner countries and regions. Although it would not be possible within the scope of this initiative to set restoration targets outside the EU-territory, the political ambition as well as the knowledge and experience gained will strengthen the EU's capacity to drive and support the international agenda on nature restoration and synergies would be built between our internal and external action.

Legal form

From an environmental perspective the preffered choice would be a Regulation because it is more precise and detailed and would frame the action to be taken by the Member States much more exactly, and hence it would bring about a higher level of coherence across the EU. For instance, it would be considerably more prescriptive in term of how restoration plan should be prepared, on its structure and content, on its review and on reporting to the Commission. Regulations, contrary to Directives, do not only indicate the goal to be achieved by the Member States, but also identify more precisely the legal requirements and means to be implemented to achieve that goal. In addition, a Regulation is the most effective way to ensure rapid action given the urgency of acting to revert biodiversity loss and ecosystem degradation. While in both cases (Regulation or Directive), Member States would need time to establish National Restoration Plans, a Directive would require an additional transposition step and thus further delay implementation.

How implementation will be ensured

There are three pillars to ensure ownership, engagement, and implementation:

1. **The development, review and implementation of the NRPs**

As described in section 5.2.2., national restoration plans will be developed by Member States. They will be submitted to for acceptance by the European Commission, i.e. the legislation would establish a process for the Commission to evaluate the plans and for the Member States to take into account the Commission's comments before adoption of the plans. When assessing the draft national restoration plan, the Commission will evaluate its completeness and its adequacy for reaching the specific targets and obligations set out in the law, as well as the overarching objective.

As desctribed in section 5.2.2. the NRPs need to include a financing plan (including EU, national, and public/private financing, and where and how to best deploy this financing). Experience shows that the implementation of legislation is hindered or slowed down due to lack of availability of funding. Proper planning will ensure that available funding sources at all levels are mobilized for the implementation of the restoration activities. Lack of cooperation with stakeholders is another key factor that can hinder implementation, and it is clear that stakeholder engagement is essential to achieve results. For this reason as described in section 5.5.2, the NRPs should include plans on how to engage with stakeholders. This should give stakeholders the opportunity to participate in the preparation of NRPs and various restoration activities, and how to address the potential needs of stakeholders that may require support, for example in transitioning to new practices, in networking and sharing of best practices, in the developing new business models that build on the benefits of improved ecosystem services.

Overall, the development of plans will be fundamental in ensuring the ownership of Member States in the various objectives and stages of planning and implementation to restore ecosystems to reach the targets. The process of review will help ensure that feedback on the objectives planned by Member States is provided, and will contribute to ensuring engagement and ownership. The adoption of NRPs that are clearly insufficient to reach the targets, could lead to infringement procedures to make sure the identified failures are rectified.

2. **Review of restoration progress**

Based on reporting by Member States and required by the legislation this will centre on restoration measures put into place. The Commission will check progress of restoration implementation, i.e. the area subject to restoration measures put into place by Member States aiming to achieve good condition of relevant ecosystems. This will allow an assessment whether the measures put into place and consequently the restored area (in quantitative terms) corresponds to the targets set and are expected to achieve the objectives of good condition of relevant ecosystems, and whether a Member State seems to be on track to reach these targets. Furthermore, this information will be verifiable and will provide objective feedback to Member States to indicate the degree to which they are on track, and in the case of non-compliance could lead to infringement procedures.

3. **Review of improvement of ecosystem condition.**

Based the reporting by the Member States as required by the legislation, the Commission will also check on progress towards good ecosystem condition. In order to alleviate administrative burden, synergies with existing reporting requirements will be sought. Whenever possible, reporting requirements under the Habitats and the Birds Directives will be used for assessing progress towards recovery of ecosystems. For those ecosystems for which no monitoring and reporting requirement exist today (that would therefore be covered in step 2), progress towards their good condition will be assessed based on future reporting requirements. Achieving good condition is the ultimate objective of restoration, which can take long periods of time to achieve for many ecosystems. As in pillar 2, this information is also verifiable and will provide objective feedback to Member States to indicate the degree to which they are on track.

The Commission will review progress on each of these pillars on a **periodic basis** to 2050, providing guidance and taking measures as appropriate. The Commission may further support the Member States in implementing the legislation, e.g. by developing guidance as needed. **Together, with the overall political impetus provided by the Green Deal, the three pillars will ensure ownership, engagement, enforcement, and implementation of the targets.**

9. HOW WILL IMPACTS BE MONITORED AND EVALUATED?

In the context of new EU nature restoration targets, it will be important to monitor both the progress of restoration measures undertaken by Member States as well as the resulting improvements in ecosystem condition. The Commission should assess in regular intervals Member States' progress towards the overarching objective as well as the specific restoration targets of the new instrument based on Member States NRPs and required reporting. Coherence with other monitoring and reporting requirements relevant to ecosystem restoration (in particular those under the BHD, MSFD and WFD but also the NEC[128] directive and others) is of strong significance and shall provide important administrative and cost synergies at Member States level. Synergies and complementarities are being planned in the **LULUCF** proposed revision, which would develop monitoring requirements on emissions and removals, in particular from high carbon stock land (see section 5.2.2.). The proposed revision would enable, in the longer term, better cross-referencing between land-based climate change mitigation and ecological condition.

While all efforts will be made to keep the burden of reporting low it will be necessary that monitoring activities by Member States are stepped up substantially because this is a precondition for planning and design of national restoration plans, the prioritisation of measures and measuring post-restoration success. The intensified use of new technologies in areas like remote sensing and earth observation (Copernicus) supported by EU funding and research and innovation policy shall accompany and support the efforts made.

- *Monitoring and evaluation in relation to the* ***ecosystem-specific restoration targets (step 1)***

In response to the ecosystem-specific targets set in the restoration instrument, Member States will have to set out restoration objectives and measures on national level in their NRPs, which they then must regularly review (also in light of better monitoring) and evaluate regarding the progress made. In addition, NRPs shall be evaluated at EU level to ensure the sufficiency and coherence of the objectives and measures to achieve the ecosystem-specific targets set in legislation.

As regards monitoring ecosystem condition by Member States (which includes the monitoring of all relevant ecosystem attributes), two levels of monitoring with different scales and intensities can be distinguished: On the level of restoration projects or programmes, outcomes need to be monitored to identify treatment effectiveness and to adjust restoration measures as required (i.e. using an adaptive-management framework). It may also be necessary to adapt target conditions of certain areas based on new findings and knowledge on the impacts and projection of impacts of climate change. Restoration, recreation and recovery of restored areas in quality & quantity shall be recorded and reported. On the national and/or (biogeographic) regional level, Member States monitor the condition and trend of habitat types and habitats of species associated with certain ecosystems according to the requirements in existing legislation (in particular Article 17

[128] Directive (EU) 2016/2284 on the National Emission reduction Commitments Directive (NEC Directive).

of the Habitats Directive and Article 12 of the Birds Directive within their 6-yearly reporting cycles). The implemented restoration projects and programmes set out in the NRPs will eventually show a positive impact on that scale of monitoring. Also, the respect of the non-deterioration requirement can be monitored that way.

- *Monitoring and evaluation* ***in preparation of restoration targets that shall be set in the future (step 2)*** *– the planned EU methodology to assess the condition of ecosystems*

In addition to established systems of condition assessment under EU environmental legislation, the development of an overall EU methodology for ecosystem condition assessment is planned for the coming years in cooperation with Member States.

The Commission and the EEA are currently preparing a proposal for an EU methodology and guidance to assess the condition of ecosystems relative to a reference condition with the help of a set of specific indicators per ecosystem type (**5th MAES report**[129], 2018). A core set with key indicators is available already and was the basis of the EU Ecosystem Assessment. The planned guidance will be aligned with the UN’s statistical standard on ecosystem accounting. It will integrate current reported data and methods to assess ecosystem condition and restoration needs for ecosystems stemming from environmental directives. It will also make proposals for assessing condition for ecosystems that are currently not covered by these directives.

- ***Mapping and Reporting***

Mapping and reporting related to the various levels of monitoring and evaluation is planned to be integrated (via the adaptation and improvement of the relevant reporting formats and guidelines also in the level of detail of e.g. habitat maps) as far as possible into existing mapping and reporting requirements under EU directives, such as the BHD, the MSFD and the WFD. Furthermore, synergies with other data-flows such as the INSPIRE Directive, the Copernicus programme, the European Biodiversity Partnership, future LULUCF reporting, data from the agricultural sector (CAP), from the Directive on reduction of national emissions of certain atmospheric pollutants (air pollution) and the growing area of citizen science shall be explored. However, a specific reporting requirement under this new instrument cannot be excluded at this stage for those aspects that cannot be sufficiently integrated into existing reporting requirements.

[129] See footnote 114: Tables 5.1-5.2 and 5.3 contain the core indicators for ecosystem condition. They can be monitored at EU level.

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COMMISSION

Brussels, 22.6.2022
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PART 2/12

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

ANNEXES

Accompanying the

proposal for a Regulation of the European Parliament and of the Council

on nature restoration

{COM(2022) 304 final} - {SEC(2022) 256 final} - {SWD(2022) 168 final}

EN EN

Annexes

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LIST OF ABBREVIATIONS

BDS2030	Biodiversity Strategy for 2030
BHD	Birds and Habitats Directives
CAP	Common Agricultural Policy
CBD	Convention on Biological Diversity
CFP	Common Fisheries Policy
EEA	European Environment Agency
ELD	Environmental Liability Directive
EMFAF	European Maritime Fisheries and Aquaculture Fund
HD	Habitats Directive
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
LAU	Local Administrative Unit
LULUCF	Land use, land use change and forestry
MAES	Mapping and Assessment of Ecosystems and their Services
MBIs	market-based instruments
MSFD	Marine Strategy Framework Directive
NEC Directive	National Emission reduction Commitments Directive (Directive (EU) 2016/2284)
NGO	Non-governmental organisation
NRP	National Restoration Plan
UNCCD	UN Convention to Combat Desertification
UNFCCC	UN Framework Convention on Climate Change
WFD	Water Framework Directive

Annex I: Procedural information

Lead DG, Decide Planning/CWP *references*

Lead DG: DG ENV

Decide Planning reference: PLAN/2020/8491

CWP reference:

In the **Commission Work Programme 2021**[1] 'A Union of vitality in a world of fragility' COM(2020) 690 final, this initiative is foreseen under the policy objectives for the European Green Deal, in particular under 'Biodiversity and toxic-free environment package': 'New legal framework on the restoration of healthy ecosystems (legislative, incl. impact assessment, Article 192 TFEU, Q4 2021)'.

Organisation and timing

The **Inception Impact Assessment** (**Roadmap**) was open for feedback from 4 November 2020 until 2 December 2020.

The **Open Public Consultation**[2] on the initiative was open for feedback online from 11 January 2021 until 5 April 2021.

An **Inter-Service Group** was set up in June 2018 to steer and provide input for the evaluation of the EU Biodiversity Strategy to 2020. In view of the close links, the same group provided steer on the EU's Sixth National Report to the Convention on Biological Diversity (6NR). In 2020, this group also undertook to provide steer and input to the impact assessment for the EU Nature Restoration Law.

The Inter-Service Group includes representatives from the Directorate Generals ENV; AGRI; BUDG; CLIMA; DEVCO (INTPA); ECFIN; ECHO; EMPL; ENER; ENV; ESTAT; FPI; GROW; JRC-Ispra; MARE; MOVE; NEAR; REGIO; RTD; SANTE; SJ; TRADE, SG. as well the EEAS. Relevant agencies, in particular EASME/CINEA, EEA have also been included in these consultations.

The ISG discussed the initiative on legally binding restoration targets on 04/09/2020, 21/01/2021, 16/03/2021, 30/04/2021, 11/06/2021 and 09/11/2022.

The **planned adoption date** in the Commission Work Programme for 2021 was **Q4 2021**, however, it has been postponed to **23 March 2022**, and then to **22 June 2022.**

[1] https://ec.europa.eu/info/publications/2021-commission-work-programme-key-documents_en.

[2] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12596-Protecting-biodiversity-nature-restoration-targets-under-EU-biodiversity-strategy_en.

Consultation of the Regulatory Scrutiny Board (RSB)

The draft Impact Assessment was submitted to the RSB on 17 June 2021. The RSB provided a first set of detailed comments its **Impact Assessment Quality Checklist** on 9 July 2021. The meeting with the RSB on the impact assessment took place on 14 July 2021. On 16 July 2021, the RSB issued a **negative opinion with comments**. DG ENV revised the Impact Assessment accordingly, addressing the comments of both the opinion and the Quality Checklist, and re-submitted it to the RSB on 1 October 2021. On 28 October 202, the RSB issued a **positive opinion with reservations**; the comments included in this second opinion have also been addressed in the Impact Assessment.

The tables below (at the end of this Annex I) give an overview of the comments by the RSB in its opinions and in the Impact Assessment Quality Checklist, and indicate how the Commission has addressed each of these comments in the revised Impact Assessment.

Evidence, sources and quality

References to key sources and evidence (not exhaustive):

Data and knowledge on the EU's ecosystems (state, pressures, trends etc.) has been drawn from published reports which are authored and reviewed by a experts in the field, such as:

- The **first EU-wide mapping and assessment of ecosystems and their services**[3] ('MAES report') by the European Commission's Joint Research Centre (2020);
- **State of Nature in the EU**[4] (European Environment Agency, 2020);
- **Regional Assessment Report on Biodiversity and Ecosystem Services for Europe and Central Asia** (IPBES, 2018)[5];
- Tucker et al., (2013) **Estimation of the financing needs to implement Target 2 of the EU Biodiversity Strategy**[6]. Report to the European Commission. Institute for European Environmental Policy.

A wide range of specific scientific sources/publications have been used for the impact assessments of the specific ecosystem/species restoration targets. They are listed in the supporting study report[7].

[3] MAES report (2020).
[4] https://www.eea.europa.eu/publications/state-of-nature-in-the-eu-2020.
[5] https://ipbes.net/assessment-reports/eca.
[6] Tucker et al., *Estimation of the financing needs to implement Target 2 of the EU Biodiversity Strategy*, 2013.
[7] To be published in 2022.

Policy-related studies/reports:

- Evaluation of the Biodiversity to 2020[8];
- Eftec et al., (2017) **Technical support in relation to the promotion of ecosystem restoration in the context of the EU biodiversity strategy to 2020**[9].

Robustness and quality of data:

As mentioned in chapter 2 (Problem definition), figures and data on biodiversity and ecosystem condition come from a variety of sources, data sets and monitoring methodologies (e.g. reporting by Member States, Copernicus land monitoring etc.) and are not always directly comparable and in some cases are based on incomplete reporting. Despite these shortcomings they do provide trends, from which clear conclusions can be drawn.

External expertise: Service contract 07.0202/2019/806106/SER/ENV.D.2: "Supporting the Evaluation of the EU Biodiversity Strategy to 2020 and Follow-up" with Trinomics B.V. leading a consortium including the Institute for European Environmental Policy (IEEP), UNEP-WCMC, IUCN and ENT environment & management. Amendment N°1 of this contract expands the scope of 'phase 2' of this contract to 'the services needed for supporting the follow-up action to the EU Biodiversity Strategy to 2030', in particular to support the Commission in undertaking an impact assessment for a proposal for legally binding EU nature restoration targets in line with the Commission's Better Regulation guidelines. The contractor is asked to 'support the development of a proposal for legally binding EU restoration targets with the aim to restore degraded ecosystems, in particular those with the most potential to capture and store carbon and to prevent and reduce the impact of natural disasters'. The concrete tasks of the contractor included support to the public and stakeholder consultations and support in all steps of the impact assessment process.

[8] Trinomics B.V. (2021) Support to the evaluation of the EU Biodiversity Strategy to 2020, and follow-up: Final study report (Publications Office of the EU, 2022). For a summary of main relevant findings: see Annex IX. Commission Report on the evaluation of the EU Biodiversity Strategy to 2020 due in 2022.

[9] Eftec et al., *Technical Support in Relation to the Promotion of Ecosystem Restoration in the Context of the EU Biodiversity Strategy to 2020*, Summary Report, European Commission, Directorate General Environment, January 2017.

RSB comments	**How did we address the comment?**
1st RSB OPINION (16 July 2021)	
(Opinion 1.1) Given that there is already a broad set of measures (both existing and recently or soon to be adopted) that tackle the biodiversity challenge and its drivers, the report should be more explicit on the **specific gap of the problem that would remain that binding targets could help solve**.	Inserted an explanation in section 2.4 (how will the problem evolve). Inserted an explanation in section 4.2, where legally binding targets are introduced, saying that they would address the specific problem gap. Explained why gap remains in section 2.2. 'Specific policy drivers'. Better description of the baseline in section 5.5 and Annex also makes this clearer.
(Opinion 1.2) It should explain **why a better implementation of existing legislation**, as concluded by the preceding fitness check, **would not be sufficient.**	Explanation added in section 2.1.1 above Fig 2 and in section 2.1.2 above table 1. Explained why gap remains in 2.2. 'Specific policy drivers'.
(Opinion 1.3) The **baseline** should be more explicit about the **degree of passive restoration that should already happen** due to the effects of existing legislation on the drivers of biodiversity loss and ecosystem degradation.	Better described baseline in 5.1 (policy option baseline) and in the Annex. and elaborated on the expected degree of restoration under existing legislation and policy initiatives in Annex VII. Added an explanation to 6.2 to highlight the added value of the options in comparison to expected restoration under the baseline.
(Opinion 2.1) Building on a sharper problem definition, the report should be **clearer about the objectives**. It needs to explain the difference between the **overarching aspirational goal** of restoring 'all ecosystems' and what this particular initiative is meant to achieve via binding targets. There is a reference to 'at least a broad range of ecosystems', however the report does not express this objective in sufficiently specific, measurable and time-bound terms.	In section 4 on objectives better explained. General objective slightly revised to be in keeping with an article of TFEU (see also checklist 4.1,4.2,4.3). Issue if "all" and "broad range" ecosystems better explained. In 5.2.1: Policy option 4 'overarching goal' re-defined and better explained. In 6.4: adapted accordingly.
(Opinion 2.2) The objectives should clarify the **reference situation** to which ecosystems should be restored. If defining the reference situation requires judgement on a case-by-case basis, the report should clarify how it would define and enforce binding quantitative restoration targets.	Reference situation: explanation added in 4.2.

RSB comments	How did we address the comment?
(Opinion 3.1) The report should better present the **functioning of the options** and assess more thoroughly their feasibility and effectiveness.	Functioning of options 2 and 4 better explained in 5.2.1 (description of options) and 6.4 (effectiveness of option 4) Feasibility and effectiveness are more thoroughly explained in 6.1-6.4 (effectiveness of options). Feasibility is furthermore incorporated in the description of achievability in 6 (approach to IA).
(Opinion 3.2) As regards the option of having a **binding overarching goal** for ecosystem restoration it should explain how the availability of the necessary data and methodology to establish and monitor an overarching goal (presumably at EU and Member State level) would be ensured and how in practice the final (quantitative) goal would be determined.	5.2.1: Overarching target: limitations of overarching target added in Option 2. Overarching objective better defined and explained option 4.
(Opinion 3.3) Given that some ecosystems (e.g. urban, soil) are not covered by EU legislation, the report should assess more thoroughly the respect of the **subsidiarity principle** and the **proportionality** of legally binding measures.	Ch. 7 (subsidiarity and proportionality) now includes a reference to the legal basis encompassing all ecosystem types An explanation was also added in the main text on why EU level action is, in terms of subsidiarity/proportionality, warranted on ecosystem types that are partially covered by existing legislation.
(Opinion 3.4) It should clarify **whether Member States can reasonably be expected** to be able to operationalise the targets for those ecosystems and habitats where there is not already an evidence base and a clear methodology and whether such option would provide the necessary legal certainty.	Further explanation added in ch 5.2.2
(Opinion 4.1) Regarding the **specific targets** for ecosystems option, the report should clearly **identify the evidence base and methodology** supporting the proposed detailed targets by ecosystem.	Explanation on evidence base included in option 3. Methodology and evidence for the specific targets described in detail in Annex IV.
(Opinion 4.2) The **views of different stakeholder groups on individual targets** should be clearly presented.	More referencing on this throughout the text How stakeholder views were included in the methodology and evidence for the specific targets now described in Annex IV.
(Opinion 4.3) Concerning the **combination option**, the report is not clear how the two options would interact in practice and why it should overall	5.2.1: Hybrid option 4 re-defined and interaction specific targets/overarching objective better described.

RSB comments	How did we address the comment?
perform best, given the shortcomings identified above with the binding overarching goal option.	6.4 Explanation added.
(Opinion 5.1) The report should elaborate on how an **EU wide enforcement** of the targets and the achievement of the objectives will be done considering that Member States will determine the specific actions to take through national restoration plans.	New section on enforcement added as a new sub-section of ch. 8. Further details also added in ch 5.2.2.
(Opinion 5.2) It also should explain how the proposed options will ensure **Member States' ownership** of the targets.	Explained in sections as above 5.2.2 and new sub-section in ch 8.
(Opinion 5.3) It is not clear how **different the efforts to be made by Member States** will be, given that they have different ecosystems and habitats on their respective territories.	Tables of costs and benefits per Member state and per ecosystem has been added in Annex III. Section on distributional aspects of targets added.
(Opinion 6.1) The report should be more explicit about **how the costs and benefits were calculated**, what **assumptions** were made and what they are based on for all ecosystem types assessed.	This is now better explained in Annex IV. Additional explanation has also been added on the costs and benefits calculation in each thematic assessment in Annex VI.
(Opinion 6.2) It should also better explain how the **opportunity costs** were estimated including what assumptions were made and how they are justified.	This is better explained in Annex IV.
(Opinion 6.3) It should also be clear **what "ecosystem services" are included in the benefit estimates** for each ecosystem type assessed.	Thematic assessments are now clearer on this, with references.
(Opinion 7.1) The report should be clearer about the **cumulative effects of the initiative on the different actors** (fishers, farmers, etc.) and any resulting **distributional impacts**.	Impacts on stakeholders addressed in Annex III and in main text, Ch 6. Workshop held that addressed this issue.
(Opinion 7.2) It should also assess the **costs for different Member States and regions**.	A breakdown of costs and benefits per Member state and per ecosystem has been added in Annex III.
(Opinion 7.3) It should reinforce the 3 assessment of the **administrative costs**, including quantification whenever feasible.	Section 6.2 and 6.3 (impacts option 2 and 3): Added a more precise admin. costs breakdown for option 2 and 3 in the form of table. Section 6.4 (impacts option 4): expanded the costs overview with a more detailed cost breakdown for both restoration and maintenance per ecosystem type, and administrative costs. Chapter 7 (comparison efficiency): expanded the comparison on administrative costs. Chapter 6 (Intro of chapter: approach to impact assessment): added what is considered as administrative costs, and added a reference to Annex VII.

RSB comments	How did we address the comment?
(Opinion 8) The **views of different stakeholder groups** should be presented more systematically throughout the report.	More referencing on this throughout the text Stakeholder views w.r.t. options added in section 5.2.2.
IMPACT ASSESSMENT QUALITY CHECKLIST (9 July 2021)	
(Checklist 1.1) The report does not sufficiently **frame the initiative**. While the annexes contain a large amount of information, it is not always clear from the report itself **how the initiative links to other elements of the Biodiversity Strategy for 2030 and to other related initiatives.** For example, it is not immediately clear how the initiative will work together with **LULUCF** – how synergies will be ensured and under which of the two frameworks measures will be monitored and progress assessed.	Moved 6.1 (impacts baseline) to 5.1 (description baseline) and elaborated on the expected degree of restoration under existing legislation and policy initiatives. Description of baseline revised to include effects of other policies more clearly. Section 6.2: Processed the degree of restoration under current legislation into the policy coherence for option 2. Section 6.2-6.4: impacts of policy options (policy coherence): explanation added linking to other elements of the Biodiversity Strategy for 2030 and other Green Deal initiatives. Section 5.2.2. Now gives a more detailed explanation of the links in the proposed LULUCF Regulation. Chapter 9: monitoring: added a paragraph on synergies with monitoring LULUCF
(Checklist 1.2) The report does not sufficiently explain the **international dimension** of the initiative. The Biodiversity Strategy for 2030 refers to all the world's ecosystems being restored. It is unclear if this initiative is meant to contribute to that, beyond setting an example and establishing a methodology that might possibly be useful to third countries.	Added text in 1.1 on international commitment to restore ecosystems. Section added on 'International dimension' at the end of Chapter 8.
(Checklist 1.3) It is not clear what the **situation is in different Member States in terms of ecosystem condition and restoration efforts**. The charts and graphs presented in section 2 of the report refer mainly to what is covered under specific legislation (i.e. the Habitats Directive). It is difficult to understand what this means at EU level and the extent to which there are differences between Member States in terms of their efforts and progress.	Added at the end of section 2.2.1 that degradation applies across the board for all the main ecosystem types. Added in 2.1.1 that the main EU assessments (EU-Wide, EEA, and State od Nature) describe the condition of all main ecosystems and give evidence of distribution effects across the EU and MS.
(Checklist 2.1) The report starts by indicating that the various specific environmental protection pieces of legislation in place are not sufficient to address the problem of biodiversity loss. If **existing policies** are not working as intended (p. 17-18), the report	An explanation on why the option of revising existing legislation was discarded at an early stage is added to Section 5.3 (options discarded at an early stage).

RSB comments	How did we address the comment?
should **explain why they are not being revised**. If evidence, for example, shows that the majority of habitats under the Habitats and Water Framework Directives do not have good ecosystem status (p. 11), this shows that there is a problem under these legislations that needs to be tackled. In fact, some legislations are being revised (e.g. the Marine Strategy Framework Directive) and it is unclear whether the expected changes would address the problems in such a way as to ensure the related ecosystems are restored.	An explanation was added to 5.1 (description baseline) on what is expected from the MSFD revision. Section 5.1 and 2.2 (problem drivers) already explain that BHD and WFD were assessed as fit for purpose and will therefore expectedly not be revised, despite the implementation challenges.
(Checklist 2.2) Moreover, the report is unclear on the **extent to which other Green Deal initiatives** and particularly the broad range of other actions under the new 2030 Biodiversity Strategy **will tackle the problem** (e.g. gaps, implementation issues etc.) and **which part of the problem remains.** The report should indicate for which specific environmental legislation revisions will be launched (as announced in the 2030 Strategy) to tackle existing legislative gaps. It should **clearly explain the specific contribution expected from binding targets on the remaining gap of the problem.**	Inserted an explanation in 2.4 (how will the problem evolve). Inserted an explanation in 4.2, where legally binding targets are introduced, on how they would address the specific restoration gap. Moved 6.1 (impacts baseline) to 5.1 (description baseline) and elaborated on the expected degree of restoration under existing legislation and policy initiatives. Baseline revised and more explicit about contributions from other policies. Section on policy coherence of Annex VIII is moved to 6.1-6.4 (impacts of policy options) and expanded, building on 5.1. Revisions of the MSFD, Climate are addressed in 5.1, and new/revisions of other legislation/initiatives are addressed in Annex X.
(Checklist 2.3) In this framework, it is not clear **what are the key drivers of biodiversity loss and ecosystem degradation that need to be tackled** by this initiative. Most, if not all, of the presented drivers (climate change, pollution, over-exploitation, invasive species, changes in land and sea use; p. 15) are being addressed by other EU and national policies.	Explanation added in 2.2. (above 'Specific policy drivers') on how restoration addresses the drivers. Mentioned also in the box/summary at the end of section 2.2.
(Checklist 2.4) When it comes to **problem drivers**, it is not clear why the intervention logic does not also list **funding challenges and the political commitment and ownership by Member States**.	Political commitment now included in section on drivers. Intervention logic has been revised.
(Checklist 2.5) The report briefly touches on the difference between protection and restoration, clarifying that a protected ecosystem is not guaranteed to evolve by itself to good condition. It is not clear however what the magnitude of the problem is. **The report does not explain the extent**	Explanations added in section 2.1.1 and also above Fig 4 and in 2.1.2 above table 1. It is (was already) also explained in 2.2 under 'Lack of comprehensive approach.

RSB comments	How did we address the comment?
of the problem beyond what is covered by the Habitats Directive annexes.	
(Checklist 2.6) The report argues that **guidance from the Commission on ecosystem restoration** was followed by some Member States 'which suggests that it was appropriate' (p. 16). It is not clear what evidence supports this statement. Could the reason not be that some Member States are more ambitious and committed about biodiversity protection and restoration than others? Could the reasons not relate to different funding and resources priorities or a lack of capacity?	The paragraph has been rephrased in the section 2.2 'Voluntary targets have been ineffective'
(Checklist 2.7) The argument that **healthy ecosystems lead to disaster risk reduction and control** (p. 15) needs more evidence or should be nuanced. It is not obvious, for example, that having more forest will lead to less forest fires or that more natural coast lines will lead to less flooding from storms (e.g. a sizeable part of the Netherlands are below sea level).	Explanation with examples and references added in 2.1.3
(Checklist 3.1) The report should better demonstrate the **respect of the subsidiarity principle.**	Addressed under Opinion 3.3
(Checklist 3.2) For the ecosystems not yet covered by EU legislation (i.e. **non-Annex I** habitats forest area) and potentially subject to a binding target, the report needs to establish the **necessity and value added of EU action for each newly added ecosystem or area** (e.g. urban, soil).	See answer to opinion 4.1. opinion. This describes how targets proposals were arrived at. Needs for targets are also described in the thematic assessments.
(Checklist 3.3) Some ecosystems or habitats might be near **border areas** and their protection and restoration would require the concerned Member States to act together. The report is not clear whether (and if so, how) the planned initiative will address this aspect. It should be also clearer on the **magnitude of the transboundary effects** across all ecosystems as well as the **frequency of "free riding" practices.**	Examples of transboundary aspects added in 3.3. Little quantitative data available. Section on transboundary issues and how to address them included. Deleted 'free riding practices' from text since we have little actual evidence.
(Checklist 4.1) When describing the **objectives**, the report is **unclear about how the Biodiversity Strategy for 2030 goals will be reached**. The strategy aims for all EU ecosystems to be restored by 2050. While this objective seems to be reproduced as the general objective also for this initiative, the linked specific objective however limits its ambition to (at least) a 'broad range of ecosystems' and introduces priority criteria according to which these should be selected (e.g. carbon capture, natural disaster impact).	General objective slightly revised (checklist 4.3) Reference to how BDS2030 will be implemented included. Revised also the explanation of specific objective. "all" and "broad range" addressed below (checklist 4.2). There is an implementation plan for the BDS2030 details of this are beyond the scope of this IA.

RSB comments	How did we address the comment?
(Checklist 4.2) The report acknowledges (in footnote 19) that "it may not be possible to restore all ecosystems". While this transparency is welcome, it is important to be clear in the **specific objectives** on **what realistically should be achieved**. The current wording of the specific objective of a broad range of ecosystem is not sufficiently expressed in **SMART** terms. It will prevent effective progress monitoring and will likely repeat the problems identified earlier in the report (p.17). For instance, it is not clear what the **specific meaning of "restored"** is. It is also not clear whether this concerns only an **EU level** objective or whether this applies also at the **Member State level**.	Meaning of 'restored' explained in section 4.2 (just above 'Operational objective' A description has been added in 4.2 of the reference situation towards which ecosystems need to be restored. Specific ecosystem types to be covered are highlighted (bold). The additions make the objectives more SMART (more specific, measurable and achievable - they were already relevant and time-bound.) Clarified in 4.2 that the specific objective applies to Member States and EU-wide.
(Checklist 4.3) In terms of (public) expectation management and coherence, it may help to present the **general objective** rather as an **aspirational long-term objective (not for 2050),** while targeting the **specific objectives** on those ecosystems where the evidence base realistically allows imposing binding targets.	Suggestion taken on board in definition of general objective.
(Checklist 4.4) The **objectives** should clarify what is the **reference situation** to which ecosystems should be restored. The report seems to indicate that it is not about restoring lost ecosystems (e.g. Brussels used to be a swamp), but about repairing the damage to still existing ecosystems. This should be made explicit in the objectives.	Reference situation explained in section 4.2
(Checklist 4.5) The report highlights the need for urgent action. **Is the 2030 horizon a realistic timeframe** considering the long time needed for concerned measures to have effect?	4.2: Explanation inserted on 'restoration' versus 'recovery'.
(Checklist 5.1) The **baseline scenario** is the one against which all options are compared. As such, section 6.1 should be integrated into 5.1 and into the narrative of the sections 6.2 through 6.4. The description of the baseline could then be more complete and useful for understanding the current situation and its likely development in the near future.	See response to Opinion 1.
(Checklist 5.2) The **baseline** should sufficiently reflect the **other Green Deal initiatives**, in particular the 'Fit for 55' package and broad set of measures announced in the new 2030 Biodiversity Strategy. It should clarify how it relates to the MIX scenario informing the initiatives of the 'Fit for 55' package. It should illustrate the evolution of the part of the problem that would be not tackled if binding target measures were not part of the new policy response.	See response to Opinion 1. Section 5.1 (description baseline) is expanded to cover the Climate Law, Fit for 55's LULUCF and RED revision, and BDS2030 measures. See also revised baseline in Annex VII.

RSB comments	How did we address the comment?
(Checklist 5.3) Given the broad set of related (legislative) measures under the Green Deal and the 2030 Strategy, the report should **avoid giving the impression that the effective delivery of the 2030 Strategy depends only on binding targets**. Similarly, the report seems to **underestimate the expected contribution of all the other measures** (as indicated in section 5.1) when claiming that "in the absence of binding restoration targets the problem … risks to be further aggravated" (p.20). The **baseline should also not assume that measures under the Green Deal will not be fully implemented** (p.20).	More precision as regards existing measures is now given and how exactly the targets can contribute. It should be understood that the binding targets would only be a component of delivery of the BDS2030, I.e to deliver on the pillar 2 on restoration. Following agreement at the upstream meeting, the baseline is continued to be estimated as the implementation of all the contributions of the existing initiatives deriving from the Green Deal, that is **realistic and as based on experience,** and does not assume their full implementation.
(Checklist 5.4) While some details are included in the annexes, the report does not sufficiently present the issue of achievability of options and of '**realistic' implementation of existing measures by Member States**.	Included in 6.4 (effectiveness option 4) and 7 (comparison) why option 4 scores higher on achievability than option 3. Realistic implementation of existing EU legislation is covered in the revised 5.1 (description baseline). Annex XI outlines restoration frameworks in a number of MS but national measures are not mapped in detail due to the voluntary nature and limited reporting.
(Checklist 5.5) The **options** are not sufficiently clear on what they aim to achieve: **Policy Option 2** aims that "by 2050, ecosystems in the EU are restored to and maintained in good status" in principle covering "a broad range of ecosystem". It is **not clear what success would look like** (e.g. how many restored ecosystems and how are "restored" and "good" defined?) and **who would be responsible** for achieving it (EU, Member States, joint responsibility?). It is also not clear how "a broad range of ecosystem" goal is easy to communicate (p.34)	Explanation added in 5.2.1 (Policy Option 2) that it applies to EU- and MS-level, that 'success' is difficult to establish. Explanation of reference situation to which ecosystems should be restored (good ecosystem status) and the meaning of 'restoration' has been added in section 4.2. What success would look like is now described in section 5.2.2.
(Checklist 5.6) Policy Option 2 envisages a "binding overarching goal" in absence of a sufficiently developed evidence base for ecosystems not yet covered by EU legislation (this would be left to the Member States). **It is not clear how sufficient legal certainty on what needs to be achieved will be provided** and **how effective delivery could be ensured**. The respective responsibilities at EU and Member State level are not sufficiently clear.	Section 5.2.1. Policy option 2 has been revised to better describe these aspects.

RSB comments	How did we address the comment?
(Checklist 5.7) More generally, the report should **better explain why option 2 is a valid one to consider**. Would changing the nature of a target (binding as opposed to the previously voluntary one) be sufficient to solve the problems identified until now? Will the flexibility it includes for Member States not risk that the objectives cannot be reached? How will it address the issues of insufficient funding and insufficient integration with other policies referred to in section 2.2?	Option 2 changed from 'goal' into 'target'. 5.2.1. Policy option 2 has been revised to better describe validitiy.
(Checklist 5.8) Given the questions that option 2 raises, the report is not sufficiently clear in **option 4** what adding this (diluted) overarching goal would bring. The report clearly states that option 2 'by itself it would most likely fail to restore biodiversity at a level required to meet EU-wide and international biodiversity objectives'(p.35).	Option 4 is redefined and better explained to distinguish from option 2. Adapted wording in 6.4.
(Checklist 5.9) For option 3, the report mentions some sub-options (e.g. different target timelines) without providing any details. Without making the report too long, the description of the option should at least briefly explain what aspects the sub-options considered.	Text has been added to explain the sub-options (different target timelines).
(Checklist 5.10) In option 3, there are very detailed targets by ecosystem (in annex V). It is mostly not clear **what is the evidence basis for these detailed targets**. The report also does not specify the opinions of different stakeholder groups on these individual targets. Without this information, it is not clear on what basis policy makers should take decisions on setting these targets.	As answered in opinion 4.1
(Checklist 5.11) As an example of the lack of evidence, it is not clear whether the proposed targets to increase green areas and tree coverage in **urban areas** would be suitable. Reducing the built surface in cities can be achieved by extending the overall surface of the city, reducing the living space by person, or replacing housing by high-rise buildings. None of these solutions seems obviously desirable.	The impact assessment on urban ecosystems has been revised and improved.
(Checklist 5.12) It is also not clear whether the "**range of ecosystems**" under options 2 and 3 would be the same or whether there is a difference in terms of ambition.	Better explained in options section.
(Checklist 5.13) For all options, it is not clear how effective **enforcement** of the binding targets would be ensured.	As answered in opinion 5.1
(Checklist 5.14) The report should be clearer about the **methodology** that would be used to **monitor and measure progress** towards the achievement of the targets. It should explain whether this is already	As answered in opinion Opinion 3.4.

RSB comments	How did we address the comment?
being developed (p. 55 seems to indicate that efforts are ongoing), whether it would apply in all options, the extent to which it would imply new requirements in addition to existing legislation ones.	
(Checklist 5.15) The report should explain how effective **ownership** for eco-system restoration will be ensured for eco-systems where **effective cooperation of third countries** (e.g. Russia, UK, Turkey, Norway) will be essential.	Section on transboundary effects included.
(Checklist 6.1) The report should better explain its **evidence base and methodology** – as it stands it is difficult to form a view about the robustness and credibility of the analysis. **Annexes III, IV and VI do not include sufficient detail.**	As answered under opinion 4.1, I.e. in Annex IV and as addressed in each revised ecosystem assessment (Annex VI). Detail on impacts has been added to Annex III.
(Checklist 6.2) For many ecosystem types, **Annex VI** does not explain how the **projected costs** were estimated, what assumptions were made and what they are based on. Although Annex IV explains that the unit costs were based on a review of "EU wide evidence" on ecosystem management costs including the "study of the costs of implementing Target 2 of the EU Biodiversity Strategy (Tucker, et al, 2013)" (Annex IV, p. 17), there are **no references to the Tucker study or systematic references to other studies in Annex VI.**	More detailed explanations and references have been provided in Annex VI. See also further details and references on the methodology in Annex IV.
(Checklist 6.3) On the benefit side, Annex IV explains that the **benefit estimates** are based on the values from studies estimating carbon sequestration and storage benefits and multiple ecosystem services. For many ecosystem types assessed, they are not referenced or the **references are incomplete in Annex VI.**	As in opinion 6: references and explanations have been added in Annex VI.
(Checklist 6.4) **Annex VI** should include explanations **how the costs and benefits were calculated**, what assumptions were made and what they are based on for all ecosystem types assessed. It should also better explain **how the opportunity costs were estimated** including what exact assumptions were made and how they are justified. It should also be clear what "ecosystem services" are included in the benefit estimates for each ecosystem type assessed.	As in opinion 6: more detailed explanations have been added in Annex VI.
(Checklist 6.5) The report should clarify to what extent the **estimates and underlying assumptions** have been cross-checked with **stakeholders**.	As in opinion 6.1 and opinion 7.
(Checklist 6.6) The **benefit cost ratios** for some of the ecosystems are very low when only the carbon benefits are taken into account but they increase, in some cases dramatically, when the ecosystem	As in opinions 6. Box on robustness of data added in Section 6.3, in option 3, conclusions. It

RSB comments	How did we address the comment?
service benefits are included. In view of significant differences between the benefit cost ratios with and without the ecosystem service benefits, the report should **explain the risks of the ecosystem service benefits being lower than expected**.	refers to annex IV ('analytical methods'))
(Checklist 6.7) The report provides some indication of **how different actors (fishers, farmers, etc) would be affected** by targets on specific ecosystems or habitats. It is not clear what the cumulative effects of the initiative would be on them. It is also not clear on the distributional impacts between the different affected groups.	As in opinion 7.
(Checklist 6.8) The report should assess (and quantify if significant) the **administrative costs** for business (farmers, fishers etc.) and citizens.	As in opinion 7.
(Checklist 6.9) It is not clear how **different the efforts to be made by Member States** will be, given that they have different ecosystems and habitats on their respective territories.	Breakdown of costs per Member State and per ecosystem has been added in Annex III
(Checklist 6.10) It is also not sufficiently clear on how the **impact on equality and non-discrimination have been considered**. Would a transparency obligation and access to justice provisions be sufficient to ensure those? How big an issue is it in this case?	Text slightly revised, not likely to be a big issue for restoration.
(Checklist 7.1) The assessment of effectiveness, coherence and subsidiarity is too important to leave entirely to the annexes. If an option will not be effective (see box 5 questions about option 2), then its efficiency or lack thereof may be of less importance. Moreover, coherence is a crucial element; thus without providing information on how options compare in terms of coherence it is difficult to arrive at a meaningful conclusion on how the options compare. For instance, how will the initiative work together with LULUCF? Will it overlap or reinforce or change the scope/measures of any of the existing environmental protection pieces of legislation? How will the different options interact with the future CAP?	As in opinion 1.3. Moved the assessment on effectiveness and coherence from Annex VIII to Chapter 6. Integrated the assessment of subsidiarity and proportionality from Annex VIII into Chapter 7. Expanded the assessment of coherence in Chapter 6.
(Checklist 7.2) It is not clear **why the report argues in favour of option 4** by stating that 'having an overarching goal makes the objectives more achievable'. As mentioned above option 2 *de facto* also concerns (only) a broad range of ecosystems and it is difficult to understand how this will help in terms of communication or gaining more support as stakeholders will notice that the Commission is not going at this stage (step 1) for binding targets covering *all* ecosystems. It is not clear from the	See reply opinion 3.1. Explanation added in section 5.2.1 Option 4. Alex: Included in section 6.4 why option 4 scores higher on achievability than option 3.

RSB comments	How did we address the comment?
analysis whether option 4 will lead to any ecosystem covered by a binding target not already included in option 3.	
(Checklist 7.3) **The choice of preferred option** should be better explained, including by better reflection the **shortcomings of option 2**. Why would option 3 not be sufficient to achieve the goals of the initiative? In terms of performance there seems to be no significant difference. As said above, the higher performance on achievability seems very much debatable, and could be argued less positive, also in view of the additional complexity (and confusion) it may introduce. It is not clear why policy options 4 performs better than option 3 in terms of proportionality.	See reply opinion 3.1. Weaknesses/shortcomings of option 2 explained in section 5.2.1. and 6.2. Why policy option 4 performs better, is now better explained in 6.4. and in 5.2.1 (Policy option 4)
(Checklist 7.4) The report should provide further elements to support the claim that a **Regulation would be better than a Directive** as it would 'enable coherent action across the EU and is the most effective way to ensure rapid action'. The implementation under all options is still left to Member States through national plans and will still rely on a methodology to be developed for the monitoring and measuring of progress. How then would the choice of instrument make a difference in this setup?	Additional explanation added at the end of Chapter 8 (under 'Legal form').
(Checklist 8.1) The report should be explicit about when an **evaluation** would be carried out.	Periodic review of progress is expanded in 5.5.5
(Checklist 8.2) The report is not sufficiently clear about how the **overarching target** would be set/calculated and how it would be **monitored**. Section 9 should be more explicit about whether existing legislation requirements would be sufficient and if not what gaps would need to be addressed.	Addressed in Opinion 3.2
(Checklist 9.1) **Stakeholder views** are not sufficiently integrated throughout the report but rather are gathered together in a single section. Section 5.4 does not provide absolute numbers, only percentages, making it difficult to understand the support behind the views presented. It is also not clear what other groups besides the citizens that were mobilised by NGOs think. It would in particular be useful to understand the views of those that will be most affected by the initiative (Member States, land owners, forest managers, farmers, fishers, industry, etc). The different views of stakeholder groups should be presented throughout the report.	As in Opinion 8.
(Checklist 9.2) It is not clear how **implementation challenges** will be addressed with this initiative when it is clearly such a crucial element. Without	See reply opinion 5.1, 5.2

RSB comments	How did we address the comment?
ownership, political commitment and adequate funding, the targets will not be reached. The report should explain this aspect more clearly.	Alex: An explanation on the use of state aid for restoration is added to Annex XII.
(Checklist 9.3) As mentioned in box 6, the report should better explain to what extent the **figures and cost-benefit analyses** it presents are **robust** and what **assumptions or estimates were included.** It should clarify to what extent the estimates and underlying assumptions have been cross-checked with stakeholders, given the 2050/70 timeline.	As in option 6.
(Checklist 9.4) It would be helpful to briefly explain in the report (rather than in the annexes) **how the specific targets were developed**. The impacts on different actors and the distributional effects across Member States should be better explained.	See answer Opinion 4.1
(Checklist 10.1) The report should **provide the main elements to enable the understanding of the situation, the context, the problem, objectives and options**. However, many of the key elements are only in the annexes making it sometimes difficult to understand the robustness of the analysis. Without making the report too long, it would be useful for instance to present an example of **how the targets for a specific ecosystem or habitat have been arrived at.**	See responses Opinion 4.1 Annex IV now includes section on how targets were arrived at.
(Checklist 10.2) The report should provide more explanations to help non-expert readers (e.g. brief explanation on MAES, Aichi Target 15, etc.). The report does not sufficiently explain the various types of actions that would be covered in terms of restoration – when is passive restoration enough? Can it only be applied in specific situations?	Explanation added on Aichi target in 1.1 (in text and footnote). Explanation added on MAES (text box) in 2.1.1
(Checklist 10.3) The section on the upstream support meeting with the RSB and the reproduced meeting minutes should be deleted. Only the recommendations of the Board opinion(s) and how the DG has responded to them need to be reported in Annex 1.	Annex I: Info of upstream RSB meeting and related follow-up table of comments deleted. New follow-up table included.
(Checklist 10.4) The report should be more systematic in presenting the sources when providing figures and findings (section 6.3 may rely on annexes and in turn on the study but it should still show sources for figures it presents). For instance, on page 14 it states that 'costs of inaction are high and are anticipated to increase' – a footnote would be better than a hyperlink as this is a rather important aspect. More generally, the report should use a unique system to reference evidence and studies. In many cases, this is done through hyperlinks, in other cases in footnotes. As	Done across the board as much as possible.

RSB comments	How did we address the comment?
not everyone consults documents in electronic format, the use of footnotes seems preferable.	
(Checklist 10.5) Acronyms should be spelled out at first use.	Done
(Checklist 10.6) The line spacing should be harmonised to the standard 1.15, as foreseen in the impact assessment template.	Done
(Checklist 10.7) In Figure 3 (p.11), it is not clear why the Baltic Sea ecosystem is presented twice, with different assessments of its status.	Fig 3 is replaced by a corrected version (one instance of 'Baltic Sea' corrected into 'Black Sea')
(RSB meeting) Is there evidence that ecosystems beyond the HD are degraded and in need of urgent restoration?	MAES, IPBES, Dasgupta and other reports showed we have big problems beyond Annex I. These are now referenced upfront.

RSB comments in its 2nd Opinion (28 October 2021)	How did we address the comment?
Overall opinion :	
The report is not sufficiently clear on the justification, functioning and performance of some options.	Addressed as detailed below.
The report is not sufficiently specific on some costs and benefits estimates and underlying assumptions.	Addressed as detailed below.
What to improve:	
1. The report should better explain how the overarching legally binding EU target option would be implemented in practice, in particular how effective monitoring, reporting and enforcement would be ensured.	Explanation provided on implementation in practice, including monitoring, reporting and enforcement.
2. The report should explain why it uses the contribution to climate change as a selection criterion for including ecosystems in this initiative. It seems that the EU has already sufficient actions to reach its climate change goals, independently of an additional contribution from this initiative. In particular, the report should better justify why it excludes sparsely vegetated land (which could have high biodiversity potential) into the list of covered ecosystems, while it includes urban ecosystems (which would seem to have 2 limited biodiversity potential).	Climate change: importance and contribution of ecosystem restoration to climate adaptation further elaborated on. In addition, it was already addressed in section 2.1.3 on p18-19 Sparsely vegetated land is no longer excluded from the assessement. As it was added late, only a partial cost-benefit analysis could be included.
3. The report should be clearer when it comes to the reference condition that ecosystems would need to be restored to. It is unclear who would decide on the conversion of various habitats and ecosystems and how this decision would be made. It should explain how trade-offs between (green) policy objectives (e.g. climate adaptation flood prevention measures vs restoration) will be managed.	Explanation inserted, in section 4.2 where reference condition is defined and in section 5.2.2 (on NRPs) on re-establishment.
4. The report should better justify why it considers the option that combines legally binding ecosystem-specific targets with an overarching objective to be	Explanations provided as to why option 4 is clearly more effective and also more proportionate.

clearly more effective than the specific target option only, given that the quantitative comparison scores differ only marginally and that the 2030 Biodiversity Strategy has already set an overarching aspirational objective. It should also better justify why the combination option performs significantly better in terms of proportionality.	
5. The report should be more specific on some costs and benefits estimates and underlying assumptions. On benefits, it should be explicit about precisely what is meant by 'ecosystem services' and the timescales for benefits occurring in the medium and long term. In view of significant differences between the benefit-to-cost ratios with and without the ecosystem service benefits, the report should be clear on the risk that these benefits will not materialise. On costs, the report should clarify the magnitude of the cost increase when referring to delayed action on restoration leading to a requirement for costlier measures. It should be more explicit to what extent it takes into account costs to surrounding ecosystems (e.g. effects of re-wetting peatland on neighbouring agricultural land).	The **method of estimating benefits** of ecosystem services is explained in section 6.3. The **types of benefits** identified are listed per ecosystem. The **risks that these benefits will not be realised** are also explained. An explanation on possible **impacts of restoration on surrounding (agricultural) land** has been included at the end of section 6.4 and annex IV.
6. While the report assumes a 'realistic' level of implementation for the measures included in the baseline, it is not clear whether the same implementation assumption has been made when estimating the costs and benefits of the options. The report has added some useful information on the cost implications at Member State level in the annex. It should briefly explain in the main text how large the difference in effort between Member States would be.	The implications of **less-than-full implementation** are explained and a costs and benefits have been calculated for alternative scenarios of 90%, 80% and 70% implementation. **Cost of implementation at Member State level**: analysis and explanation included at the end of section 6.4.
7. The report should not only report on stakeholder views but also show how the input received has been taken into account. The Board notes the estimated costs and benefits of the preferred option in this initiative, as summarised in the attached quantification tables.	In each of the boxes on stakeholder views, explanation has been added on how this feedback has been taken into account.

Annex II: Stakeholder consultation

Due to its size, the stakeholder consultation synopsis report is provided as a separate document.

Annex III: Who is affected and how?

Practical implications of the initiative

Restoration of ecosystems has been shown to be cost-effective, but **requires investment** that incurs financial and opportunity costs for managers of land and natural resources, who may be compensated through incentives provided by governments and buyers of ecosystem services. Restoration programmes will provide employment and incomes for ecosystem managers and local communities, restoration and remediation businesses, and benefit society and the economy as a whole and sectors which rely on particular ecosystem services.

Social benefits to citizens/society as a whole include **new opportunities for jobs and skills**[10], positive effects on **physical and mental health**[11], enhanced **natural and cultural heritage and identity**[12], enhanced quality and security of **food and water**[13], and **enhanced resilience of communities to climate change and natural hazards**[14].

A failure to act to address the poor and declining state of ecosystems and their services will impact negatively on businesses and citizens across Europe and worldwide, while jeopardising the achievement of climate and wider environmental policy goals.

Who will be affected (see also table III-5):

- The proposed initiative addresses Member States and thus affects primarily authorities at national, regional and local level which play a role in mapping and assessment of ecosystems and their services, and in planning, funding, implementing and monitoring restoration programmes. Likely affected public institutions include environmental, agricultural and climate authorities, statistical offices and research institutes, and agencies dealing with zoning and territorial planning. Impacts differ between EU Member States and mainly depend on the extent of ecosystems on their territories, the levels of degradation and associated magnitude of restoration required, and different levels of costs associated with restoring different types of ecosystems. An overview of total estimated combined costs of implementing the combined proposed restoration targets for Annex I habitats (forests, grasslands, inland and coastal wetlands, rivers & lakes and heaths & scrubs) for each EU Member State is provided in Table III-4 below. The estimated benefits per Member State widely exceed the costs and are presented in Table III-3. The more detailed assessment of costs and benefits per ecosystem are provided in Annex VI. Analytical methods in general are explained in Annex IV.

[10] *The EU biodiversity objectives and the labour market: benefits and identification of skill gaps in the current workforce*, European Commission, 2012.

[11] *The Health and Social Benefits of Nature and Biodiversity Protection,* IEEP, 2012.

[12] Natura 2000 Cultural heritage.

[13] See footnote 3.

[14] *Ecosystem resilience for mitigation of natural disasters*, Nordic Council of Ministers, August 2017.

- Land managers – including farmers, foresters and nature conservationists – are responsible for the management and restoration of terrestrial ecosystems. The impacts on them can be expected to be both one-off and recurrent, with land managers expected to be impacted by one-off costs (as shown in Table III-5 below) relating to potential, initial changes in land use management practices. Furthermore, the scale of impacts on land managers varies considerably between ecosystems and habitats, and between biogeographic regions. For example for forests, approximately 40 % of the forest area in the EU is publicly owned, and public ownership dominates in most of the Eastern and South-Eastern Member States. As such, incentives to stimulate both private and public actors to implement restorative actions within contrasting Member States will also vary. To incentivise restorative actions by land managers throughout the ecosystems analysed within this Impact Assessment, costs such as those involved in restoration actions, opportunity costs relating possible changes in land use (such as agricultural land impacted by freshwater barrier removals), and changes in the costs related to marketable goods and services all need to be considered (see methodology in Annex IV).

- A range of sectors using and harvesting natural resources – such as fisheries, the water sector and the extractive industries play an important role in sustainable management and restoration. For most of the ecosystems outlined in Table III-5, it can be expected that significant one-off and recurrent costs will be imposed on these stakeholders. In ecosystems which are more intensely managed for resource extraction (such as forests), changes towards 'nature-based' or 'climate smart' management would to some degree depend on the willingness, know-how and adaptability of the sectors. However, extractive industries can also be expected to benefit from restoration actions, such as reduced costs to water purification from reduced water pollution (due to agro-ecosystem and freshwater ecosystem enhanced conditions), enhanced recreation-related revenues, and improved resilience against climate-related impacts.

- Sectors responsible for emissions and discharges to land and water – such as the manufacturing, energy, transport, agriculture and waste treatment sectors – play an important role in enhancing the condition of ecosystems through reduced point source and diffuse pollution. Across all ecosystems, these sectors can be expected to be impacted by restoration needs and actions, to abide to the Polluter Pays Principle. However, as outlined in the bullet below, the costs of complying with environmental regulation can be balanced by a multitude of benefits derived from restoration actions.

- A wide range of sectors and stakeholders benefit from enhancements in ecosystem services. For example, the agri-food sector benefits from an improved condition of soils, water resources and conservation of pollinators; fisheries benefit from enhanced fish stocks and more sustainable marine and freshwater management; water companies benefit from enhanced water purification; property owners, insurers as well as inhabitants benefit from reductions in floods and natural hazards; and the tourism sector benefits from enhanced landscape and biodiversity. Cost-efficiencies can be garnered by such sectors through investing in restoration and nature-based solutions to comply with environmental legislation whilst also lowering medium-long term operating costs. For example, through investing in improving freshwater condition, the availability of resources extracted from such ecosystems (such as clean water for industrial processes) can be enhanced which can lower operating costs and reduce the likelihood of resource scarcity in the future.

- Society as a whole benefits from increased climate change mitigation and adaptation and from improved disaster risk management.
- The financial sector can contribute to restoration and is also subject to the risks posed to the economy by biodiversity loss and ecosystem degradation, as its investments can be highly dependent on ecosystem services.

Finally, it should be noted that a plethora of tools are currently in place for stakeholders to utilise to achieve the outlined restoration targets in the coming years. In particular, to support the transition to enhanced ecosystem condition and to compensate the stakeholders noted above who may experience foregone income, incentive payments and opportunity costs can be compensated through EU, national, regional, local and private funds. For example, existing payments under the CAP already link payments related to environmental conditions. Such payments can be expected to further increase in their scope and scale due to the enhanced budget under the Multiannual Financial Framework (MFF) towards climate and biodiversity issues. Besides the agreement to invest at least 25% of the EU's expenditure in measures that contribute to climate action, by 2024 7.5% of MFF annual spending is to be directed towards biodiversity objectives - and 10% as from 2026, which will alleviate the costs of transition required by stakeholders to achieve restoration targets. Implementing EU restoration targets would provide a direct contribution to both mainstreaming targets.

Summary of costs and benefits

Table III-1: Overview of benefits of the preferred option – until 2070

Overview of benefits for the preferred option – until 2070 (Present Value)					
	Scenario A (15-40-100% targets for 2030-2040-2050)		Scenario B (30-60-100% targets for 2030-2040-2050)		
Restoration of ecosystem type	**Carbon benefits in EUR million**	**Benefits from all ecosystem services (including carbon) in EUR million**	**Carbon benefits in EUR million**	**Benefits from all ecosystem services (including carbon) in EUR million**	**Beneficiaries and further comments**
Peatlands	10 629	38 702	13 042	47 488	- Entire population and economy through carbon benefits; - Companies and consumers, and the tourism sector.
Marshlands	(na)	6 388	(na)	7 838	
Coastal wetlands	1 091	181 614	1 339	222 842	- EU inhabitants, especially 55.7 million people who are estimated to live in coastal zones by 2060; - Fishers and farmers as well as related value chains.
Forests	3 832	203 564	4 701	249 775	- The economy, including tourism/ recreation sectors, and conservation organisations, especially in rural economies.
Agro-ecosystems	17 073	229 589	18 624	250 451	- Farmers and the agricultural sector benefit from improved soils quality, reduced soil erosion and soil compaction, greater abundance of pollinators, etc.
Steppe, heath and scrub	3 971	24 191	4 722	28 768	- Tourism sector, farmers. - Society and the economy, through the delivery of enhanced ecosystem services
Rivers, lakes and alluvial habitats	(na)	862 349	(na)	1 053 042	- Local populations through increased safety and house prices due to decreased flood risk potential - Water suppliers and consumers through overall reduced water pollution and increased availability - Recreational users of freshwater ecosystems through greater access to previously restricted areas (due to barrier removal) and enhanced aesthetic values - Society at large through enhanced ecosystem services.

Overview of benefits for the preferred option – until 2070 (Present Value)					
	Scenario A (15-40-100% targets for 2030-2040-2050)		Scenario B (30-60-100% targets for 2030-2040-2050)		
Sub-total	***36 596***	***1 546 397***	***42 428***	***1 860 204***	This excludes benefits for non-Annex I habitats as well as marine, urban, soils and pollinators.
Marine	(na)	(na)	(na)	(na)	No monetary estimates available. However, EU citizens and economic sectors (e.g. fishing/ aquaculture/ tourism/ energy) benefit in terms of climate change mitigation as well as improved biodiversity, water quality and land and seascapes.
Urban	(na)	(na)	(na)	(na)	No monetary estimates available. However, urban dwellers would experience benefits in terms of flood prevention, biodiversity, human health, property values, air and water pollution as well as climate (e.g. heat control)
Soils	(na)	(na)	(na)	(na)	No monetary estimates available. However, citizens and farmers would experience benefits in terms of climate change mitigation, biodiversity, flood risk mitigation, water quality control, sustainable use of rewetted land, erosion control, increased crop yields and productivity, soil organic carbon, and soil fertility
Pollinators	(na)	(na)	(na)	(na)	No monetary estimates available. However, EU citizens, farmers and related supply chains as well as beekeepers would experience benefits in terms of crop and plant pollination, natural biological control, decomposition of organic matter, tourism, and culture and aesthetics.

Notes:

- The general method for assessing the benefits is described in Annex IV. Details of the calculations for the individual ecosystem types are provided in Annex VI.
- Benefits until 2070 are given to take into account the benefits from restoration measures undertaken up to 2050, especially in the final years, of which benefits would only be visible beyond 2050. The figures presented are the sum of the present value of annual benefits flows, applying a social discount rate of 4%.

- The overview includes monetary estimates for benefits for many of the ecosystem services, depending on the availability of monetary data. Estimates are mostly only possible for HD Annex I habitats, because of the difficulty of quantifying the extent of ecosystem restoration needed for other ecosystems. This means that the benefits for targets that extend beyond Annex I are not included, among which, marine, urban, soils and pollinators.
- Moreover, some benefits of ecosystem services are difficult, if not impossible, to be captured in monetary terms for all the ecosystem categories, such as the intrinsic value of nature and species, moral, aesthetic, spiritual and socio-cultural benefits and relational values with nature.[15] These can be important and sometimes decisive in decision making and need to be considered in addition to the monetary benefits.
- Annex VI provides for some ecosystem types a range of minimum and maximum monetary benefits; in such instances the overview above includes the average.
- Although the 2050 target aims to restore 100 % of the habitat, the estimation of costs and benefits is for 90 % restoration as this is the maximum percentage that can be expected in practice for most ecosystems.

Table III-2: Overview of costs of the preferred option – until 2070 (Present Value)

Overview of costs for the preferred option – until 2070						
Action	**One-off costs in EUR million**	**Annual costs in EUR million**	**Total in EUR million for scenario A**		**Total in EUR million for scenario B**	**Comments**
Costs for restoration and maintenance per ecosystem type for both Member States and businesses						
Peatlands			4 779		5 125	These restoration and maintenance costs include re-creation costs and foregone income losses for businesses for Annex I habitats. The sub-total excludes non-Annex I habitats as well as marine, urban, soils and pollinators.
Marshlands			3 643		3 721	
Coastal wetlands			5 141		5 852	
Forests			50 082		53 850	
Agro-ecosystems			26 559		27 732	
Steppe, heath and scrub			3 051		3 111	
Rivers, lakes and alluvial habitats			35 232		40 211	
Sub-total			***128 487***		***139 602***	

[15] See the following resources for more information: Valuing nature's contributions to people: the IPBES approach - ScienceDirect; EUNCA_SynthReport_4_2_CSERGE_Year2_190115_sent.pdf (europa.eu); The IPBES Preliminary Guide on Multiple Values of Nature (aboutvalues.net)

Overview of costs for the preferred option – until 2070					
Action	**One-off costs in EUR million**	**Annual costs in EUR million**	**Total in EUR million for scenario A**	**Total in EUR million for scenario B**	**Comments**
Marine, urban, soils, pollinators			(na)	(na)	Quantitative cost estimates are not available
Costs for enabling measures for Member States					
Surveys of ecosystems	1 099				
Development of national restoration plans	12.8				
Development of methodologies and indicators (5 ecosystems)	6.6				
Administration of restoration measures		438.3			
Monitoring of restored ecosystems		20.6			
Reporting progress against restoration targets		0.1			
Sub-total	***1 118.4***	***459***			
Costs from 2022 to 2050	***1 118.4***	***12 854***	***13 972.4***	***13 972.4***	
Total costs: restoration, maintenance and enabling measures					
Total			***142 459.4***	***153 574.4***	This excludes restoration and maintenance costs for non-Annex I habitats, and marine, urban, soils and pollinators, as well as opportunity costs of potential land use changes (e.g. turning grassland into an industrial site).

Notes:

- The general method for assessing the costs is described in Annex IV. Details of the calculations for the individual ecosystem types are provided in Annex VI and for the enabling measures/administrative impacts in Annex VII section 4.

- All cost ‘actions’ are foreseen to be undertaken up to 2050, except for maintenance costs, which extend to 2070. The figures presented represent the sum of the present value of annual costs, applying a 4% annual social discount rate.
- Monetary figures can mostly only be estimated for HD Annex I habitats, because of the difficulty of quantifying the extent of action required for other ecosystems, which means that the costs for targets that extend beyond Annex I are not included, among which, costs for and marine, urban, soils and pollinators.
- Costs for enabling measures are given only for scenario A but are foreseen to be virtually the same for scenario B; under scenario B most of these costs would be borne in earlier years whereas under scenario A more costs would be borne later. In Annex XII the average of both scenario A and B is taken to arrive at a total estimate of costs, which means that the total cost figures may differ slightly from figures in this table.
- More precise cost figures for each ecosystem can be found in Annex VI. Annex VI provides for some ecosystem types a range of minimum and maximum costs; in such instances the overview above includes the average.
- A qualitative assessment of costs for different stakeholder groups is provided in table III-5.

Table III-3: Estimated annual benefits of Ecosystem Restoration and Maintenance, by Member State, 2022-2050 (€m)

The table presents estimates of annual benefits of ecosystem restoration and maintenance over the 2022-2050 period, for those ecosystems for which full benefits assessments have been made, and for which data on the extent and condition of ecosystems in each Member State are available. The benefits estimates presented are those under the option to restore 15% of ecosystems by 2030, 40% by 2040 and 90% by 2050. The benefits are greater under the 30%, 60% and 90% option, because earlier restoration of ecosystems delivers larger aggregate benefits over the 2022-2050 period. The benefits estimate breakdowns are based on data provided by the European Environment Agency on the extent of each ecosystem in each Member State.

The figures exclude estimates for Romania, owing to uncertainties regarding the true extent and condition of ecosystems in that Member State.

The benefits estimates relate to the increase in total ecosystem services for each ecosystem. As they are expressed as annual averages to 2050, they give slightly different benefit cost ratios than obtained by comparing the present value of benefits and costs to 2070.

The aggregate benefits across these seven ecosystem types average €64 billion per annum for the EU27. The largest benefits are enjoyed by France (€14.6bn), Finland (€9.7bn) and Spain (€7.9bn) the Member States with the largest areas of these ecosystems. The distribution of benefits differs slightly from costs, as the benefit cost ratios for some ecosystems (e.g. coastal wetlands and freshwaters) are higher than for others (e.g. forests), so Member States with the largest area of those high benefit ecosystems benefit disproportionately.

There are significant variations in the costs for different ecosystems across Member States, with the distribution of benefits mirroring that for costs, as discussed in Table III-4 below.

Factors affecting the overall benefit estimates by Member States are:

- The extent of each ecosystem in each Member State, particularly for ecosystems with high benefit cost ratios such as coastal wetlands and freshwaters;
- The condition of each ecosystem in each Member State. Some Member States (e.g. Austria, Germany, Greece, Italy, Sweden) have relatively large areas of some ecosystems but also record a relatively small proportion to be in not-good condition, such that benefits of restoration and maintenance are relatively low compared to ecosystem area.

	Coastal wetlands	Freshwaters	Forests	Grasslands	Heath, steppe & scrub	Peatlands	Total
AT	7	690	47	27	1	1	774
BE	16	494	84	35	-	2	631
BG	17	306	0	288	18	0	630
CY	1	17	17	1	2	-	38
CZ	0	242	44	74	-	1	361
DE	731	1,594	89	166	1	13	2,595
DK	2,271	761	49	79	-	10	3,171
EE	6	380	23	25	-	15	449
ES	426	1,932	2,209	2,851	515	6	7,939
FI	381	7,327	613	5	272	1,094	9,694
FR	854	7,517	3,350	2,752	93	52	14,618
GR	352	154	18	14	3	-	541
HR	0	352	1	269	-	0	622
HU	300	785	136	170	0	1	1,392
IE	437	1,259	1	144	4	76	1,922
IT	87	1,626	236	437	33	5	2,424
LT	-	1,001	25	41	-	15	1,081
LU	-	3	0	29	-	-	32
LV	15	471	27	82	-	17	611
MT	0	0	-	1	1	-	2
NL	894	123	6	30	-	2	1,056
PL	496	4,124	316	1,020	1	24	5,981
PT	3	43	26	766	67	11	915
RO	-	-	-	-	-	-	-
SE	228	4,191	802	400	-	260	5,881
SI	0	226	116	73	1	0	415
SK	0	97	195	179	2	0	473

EU 27	**7,522**	**35,715**	**8,431**	**9,963**	**1,015**	**1,603**	**64,249**

Table III-4: Estimated annual costs of Ecosystem Restoration and Maintenance, by Member State, 2022-2050 (€m)

The table presents estimates of annual costs of ecosystem restoration and maintenance over the 2022-2050 period, for those ecosystems for which full cost estimates have been made, and for which data on the extent and condition of ecosystems in each Member State are available. The cost estimates presented are those under the option to restore 15% of ecosystems by 2030, 40% by 2040 and 90% by 2050. The average annual costs for the 30%, 60% and 90% option are similar, but they are more evenly phased over the period. The cost breakdowns are based on data provided by the European Environment Agency on the extent of each ecosystem in each Member State.

The figures exclude estimates for Romania, owing to uncertainties regarding the true extent and condition of ecosystems in that Member State.

The aggregate costs across these seven ecosystem types average €7.4 billion per annum for the EU27. The largest costs are incurred in France (€2.1bn), Spain (€1.5bn) and Finland (€0.9bn), the Member States with the largest areas of these ecosystems.

There are significant variations in the costs for different ecosystems across Member States. For example, the largest costs for each ecosystem are, in order of magnitude, as follows:

- Coastal wetlands - Denmark, the Netherlands, France and Germany;
- Fresh waters – France and Finland;
- Forests – France and Spain;
- Grasslands – Spain and France;
- Heath, steppe and scrub – Spain and Finland;
- Peatlands – Finland and Sweden.

Factors affecting the overall cost estimates by Member States are:

- The extent of each ecosystem in each Member State;

- The condition of each ecosystem in each Member State. Some Member States (e.g. Austria, Germany, Greece, Italy, Sweden) have relatively large areas of some ecosystems but also record a relatively small proportion to be in not-good condition, such that costs of restoration and maintenance are relatively low compared to ecosystem area.

	Coastal wetlands	Freshwaters	Forests	Grasslands	Heath, steppe & scrub	Peatlands	Total
AT	0.3	44.0	15.5	4.1	0.4	0.2	64.5
BE	0.7	31.5	27.5	5.2	-	0.3	65.3
BG	0.7	19.5	0.0	43.5	5.6	0.0	69.4
CY	0.1	1.1	5.4	0.2	0.6	-	7.3
CZ	0.0	15.4	14.2	11.2	-	0.1	41.0
DE	31.6	101.6	29.1	25.0	0.4	1.9	189.6
DK	98.2	48.5	16.0	11.9	-	1.5	176.2
EE	0.2	24.2	7.4	3.8	-	2.2	38.0
ES	18.4	123.1	720.6	430.3	157.6	0.9	1 450.9
FI	16.5	467.0	200.1	0.8	83.3	163.5	931.2
FR	36.9	479.1	1 092.7	415.4	28.5	7.7	2 060.3
GR	15.2	9.8	5.8	2.2	1.0	-	34.0
HR	0.0	22.4	0.3	40.6	-	0.0	63.4
HU	13.0	50.0	44.5	25.7	0.1	0.2	133.4
IE	18.9	80.2	0.5	21.8	1.2	11.3	134.0
IT	3.7	103.7	76.9	65.9	10.2	0.7	261.1
LT	-	63.8	8.1	6.3	-	2.2	80.3
LU	-	0.2	0.0	4.3	-	-	4.5
LV	0.6	30.0	8.9	12.4	-	2.5	54.4
MT	0.0	0.0	-	0.2	0.2	-	0.4
NL	38.7	7.8	2.0	4.6	-	0.3	53.4
PL	21.4	262.8	103.1	154.0	0.3	3.6	545.3
PT	0.1	2.7	8.4	115.7	20.4	1.6	148.9
RO	-	-	-	-	-	-	-

SE	9.9	267.1	261.5	60.4	-	38.8	637.6
SI	0.0	14.4	37.7	11.0	0.2	0.1	63.3
SK	0.0	6.2	63.6	27.0	0.6	0.1	97.5
EU 27	**325.2**	**2 276.3**	**2 749.8**	**1 503.6**	**310.5**	**239.6**	**7 405.0**

Table III-5: Costs for different stakeholders

Darker blue indicates higher costs: significant-, moderate- and some impact (non-monetary costs/impacts are also taken into account).

		Public Authorities		**Farming/forestry sectors**		**Fishing sector**		**Nature Managers**	
		One-off	Recurrent	One-off	Recurrent	One-off	Recurrent	One-Off	Recurrent
Inland wetlands and peatlands	Re-wetting at least 25 % of HD Annex I peatland habitat area degraded due to drainage								
	Restore all HD Annex I peatland habitat area to good condition								
	Re-create the area necessary to achieve Favourable Conservation Status of HD Annex I peatlands								
	Restore and re-create area to improve status of EU-protected species associated with inland wetlands and peatlands								

	Peatland converted to cropland- Reduce by 15 % the area of managed or drained organic soils that are losing carbon								
Forests	Restore all HD Annex I forest habitat area to good condition								
	Restore and re-create area to achieve FCS of EU protected species associated with forests								
	Restore degraded non-Annex 1 habitats forest area to a good condition								
Steppe, heath and scrub	Restore all HD Annex I steppe, heath and scrub habitats to good condition								
	Re-create habitat area required to achieve FCS of HD Annex I steppe, heath and scrub habitats								
	Maintain, restore and re-create steppe, heath and scrub habitats as necessary to achieve FCS of EU protected species associated with steppe, heath and scrub								
Agro-ecosystems	Restore all HD Annex I agricultural habitats to good condition								

	Re-create additional habitat area required to achieve FCS of HD Annex I agricultural habitats								
	Restore and recreate agro-ecosystems as necessary to increase the populations of common farmland birds as measured by the common farmland bird indicator								
	Restore and recreate agro-ecosystems as necessary to achieve the secure status of birds that are predominantly associated with agro-ecosystems								
	Maintain, restore and re-create agro-ecosystems as necessary to achieve FCS of EU protected species associated with agro-ecosystems								
	Restore or recreate semi-modified and seminatural grassland								
	Restore or recreate unploughed / untilled grassland to replace historic losses								
Rivers, lakes and alluvial habitats	Restore all HD Annex I freshwater and alluvial habitat area to good condition								

	Re-create area as necessary to achieve FCS of HD Annex I rivers, lakes, and alluvial habitats								
	Develop an inventory of barriers to longitudinal and lateral connectivity of rivers and a detailed plan of which barriers will be removed, to achieve free-flowing status where possible and necessary to restore the habitats depending on such connectivity								
	Mapping out of small water units, identify their restoration and recreation potential and assess their contribution to improve connectivity between habitats as part of high diversity landscape features, contributing to the restoration of habitats and species.								
Marine	Restore EU marine habitats, prioritizing Annex I habitats.								
Coastal wetlands	Restore all HD Annex I wetland habitat to good condition								
	Re-create area as necessary to achieve FCS of Annex I wetland habitats								

	Restore and re-create the area to enhance the conservation status of EU protected species associated with coastal wetlands								
Urban	No net loss of green urban space, including tree canopy cover, by 2030, compared to 2021, within each LAU containing cities, towns and suburbs; A national average increase in the area represented by green urban space, including tree canopy cover, across LAUs containing cities, towns and suburbs, of at least 3% of the total area of these LAUs by 2040 and at least 5% of the total area of these LAUs by 2050, compared to 2021**.**								
	A minimum of 10% tree canopy cover in each LAU containing cities, towns and suburbs by 2050.								
Soils	Package of measures to conserve and increase SOC in organic soils under agricultural use								
	Package of measures focused on improving SOC on forest soil								

Pollinators	Target to restore 30-60-90 % of Annex I habitats to good condition in grasslands, heaths and scrub, wetlands, and forests categories, with no additional actions specifically targeted at pollinator conservation								
	Target to reverse trends in pollinators listed in the EU Habitats Directive								
	All necessary restoration and re-creation actions taken to restore pollinator populations by 2030, including through the following intermediate actions:								

Annex IV: Analytical methods

For many ecosystems there are data gaps and it can be difficult to specify all aspects of an ecosystem to a high degree of accuracy – rather, it is possible to make key observations, identify salient features, predict trends, estimate risks and costs and benefits, based on a range of sources. This can be in contrast to other policy areas where more information is readily available in numerical, monetary form, or where extensive simulation models exist, in areas such as climate change. This underlines the need to anchor work on the best available data sources. These include information resulting from the reporting requirements the Birds- and Habitats Directives (BHD), Water Framework Directive (WFD), and the Marine Strategy Framework Directive (MSFD), as well as the work on the Mapping and Assessment of Ecosystem Services (MAES), and others.

It is for these reasons that this impact assessment is based on a balance of qualitative and quantitative approaches and estimates, both in the development of the baseline and trends, as well as the costs and benefits of specific options. This is in keeping with many reports on the state and evolution of nature or ecosystems. Moreover, when it comes to making estimates of costs and benefits, as outlined in chapter 6 and annexes VI and XII, this can only partially be based on numerical values and numerical monetary estimates. This is not only due to the lack of data of certain costs and benefits, but also because some of the values of nature may not be reducible to monetary terms alone.

Evidence base and methodology to develop the specific targets:

The following describes how the evidence base and methodology used to develop the specific targets, and how stakeholder views were integrated in the process:

1. A first workshop with EU Member State experts in December 2020 provided evidence of the need and support for both an overarching target/objective, as well as specific targets focussing on specific ecosystems or species groups.
2. To develop specific targets that would address practically all ecosystems in a systematic manner, it was decided to use a categorisation of main ecosystem types in the EU. This was based on extensive work of MAES (Mapping and Assessment of Ecosystems and their Services), which categorises the main ecosystem types in the EU and reviews their state, trends, services and the pressures they are exposed to.
3. Some proposals for specific targets had already been developed and were described in the Biodiversity Strategy for 2030, for example on reversing the decline of pollinators, or that fee flowing rivers should be restored.
4. A stakeholder workshop was held in February 2021 to explore initial ideas for targets for each of the main ecosystem types, based on the requirement defined in

the Biodiversity Strategy to 2030. At the workshop only some initial concepts for further targets emerged; however, there was confirmation that targets for specific ecosystem types were needed, and that these, if possible, should be based on areas to be restored. Some stakeholder groups had developed more detailed ideas for topics for specific targets in background papers, in particular by environmental NGOs (e.g. WWF, the EEB and Birdlife International).

5. Building on the above, a number of meetings were held to discuss the specific targets making use of extensive in-house DG Environment expertise, for all ecosystem types. This helped develop further concepts for targets such as on free-flowing rivers, marine ecosystems, wetlands, forests, heathland and scrub, soils, urban and others. Targets relating to Annex I habits tended to fall into one group with similar characteristics, and non-Annex one related targets into another. This was because extensive data is available for Annex I related targets, and less so for the other group.
6. Meetings were also held with the EEA and the JRC on suggestions across the range of potential specific targets.
7. DG Environment then made an analysis and listing of the various targets proposed. Subsequently, requests were made to the EEA and the JRC to further assist with the descriptions and definitions of these. For example, requests for the EEA to develop fiches on Annex I related targets estimating area potential percentage based on MS data. The JRC also contributed to developing fiches for targets for other ecosystems such as for soils and urban ecosystems. Based on this a list and detailed description of targets to be impact assessed was developed and forwarded to the contractor for further analysis.
8. Some adjustments and fine-tuning to all these targets were also made with the contractors as part of the impact assessment study. As part of the study, an analysis fiche was developed for each main ecosystem type and for all targets proposed therein.
9. A second stakeholder workshop held in April further explored views on definitions and the need for an overarching target.
10. To gain further feedback on the targets from stakeholders, the specific targets were presented to stakeholders at a third stakeholder workshop in May 2021. At this workshop, no objections were raised to the targets proposed, however several questions remained on their detailed form and their foreseen implementation. Therefore a fourth stakeholder workshop in September 2021 provided for an overall presentation or all the targets and more detailed feedback on the specific targets proposed.

Approach to thematic assessments:

Given the significant differences in the characteristics of broad ecosystem types, their condition and restoration needs, and required measures to meet them, at the start of the impact assessment process the assessment was subdivided in ten thematic areas. For each of them a targeted impact assessment was undertaken in line with guidance on impact assessments in the EU better regulation toolbox. The selection of these areas was based on the 12 broad ecosystem types under the MAES typology, with some slight modifications: Grassland and cropland were merged in a single assessment for agro-ecosystems, and wetlands were split into two separate assessments for inland wetlands (marshland and peatland) and coastal wetlands (in which marine inlets and transitional waters were included). For (deeper) coastal, marine shelf and open ocean ecosystems a single marine assessment was undertaken. Sparsely-vegetated lands were excluded from the assessment for their relatively low relevance for the objectives of the legally-binding initiative. In addition, two more cross-cutting thematic assessments were added for soil ecosystems and pollinators given their particular importance in supporting healthy ecosystems.

In close cooperation between experts from the European Commission (including the JRC), EEA and the contractor preparing the impact assessment study, for each ecosystem type the current extent, condition, and high-impact pressures and threats were identified through desktop study (seen Annex VI and VIII). For the baseline assessment, informed assumptions were then made on their likely future development including through modelling trends of the last 10-20 years towards 2030 in line with the EU Ecosystem Assessment. Where necessary these were further underpinned by detailed reporting data especially from the State of Nature Reporting (Art 12 Birds Directive & Art 17 Habitats Directive), reporting under the WFD (in the case of rivers & lakes and coastal wetlands) and MSFD (in the case of the marine assessment) as well as other sources such as other EU-wide environmental indicators on relevant pressures and threats such as climate change effects, water- and air pollution. In addition, baseline assessments for each ecosystem type included an evaluation of realistic levels of restoration action to be expected towards 2030 (and in more general terms 2040 and 2050) for example in the framework of the above-mentioned EU Directives. This information was obtained from extensive evidence on progress made in restoration in the evaluation of the EU Biodiversity Strategy to 2020, implementation reports, recent fitness checks of EU nature- and water legislation, findings from implementing the EU Action Plan for Nature, People and the Economy, recent impact assessment studies of related initiatives such as the EU climate law and -adaptation strategy, evaluation reports of key cross-cutting policies such as the EU’s Common Agricultural- and Fisheries policies, recent evidence on nature and green infrastructure investment plans of Member Status outlined in the Prioritised Action Frameworks for Natura 2000, foresight studies on the development of key socio-economic trends such as urbanisation and rural depopulation as well as on key economic sectors such as agriculture and forestry, and expert judgement on the impact of recent EU decisions for example on the EU’s Multi-annual Financial Framework (MFF).

Given the large diversity of restoration needs and -challenges within each broad ecosystem type, and possible target options to address them, a screening exercise was undertaken to identify the most suitable ones. This screening involved a first assessment on the relevance to the three core objectives of the legally-binding initiative: Biodiversity (primary) and climate change mitigation- and adaptation (secondary), as well as the enforceability of target options (e.g. is a target based on existing legal commitment) and a preliminary cost-benefit analysis. Based on this assessment, target options were screened in or out. Where possible, targets were considered that could build on existing EU-wide legal commitments and the monitoring & reporting systems underpinning them, especially under the Nature Directives, the MSFD and WFD. For screened-in targets, a second assessment was made if the target could be introduced immediately ('Step 1' target) or whether it would require more preparatory work e.g. on definitions, indicators, monitoring & evaluation, baseline etc. ('Step 2'). On target options shortlisted for 'Step 1', a detailed impact assessment was undertaken. After the short-listing of viable options, a selection was made of combinations of target options that were as much as possible complementary and mutually exclusive, to avoid overlap in assessment of impacts as much as possible in case of combined targets.

In the thematic assessments, the costs and benefits of meeting each short-listed target for Step 1 were then quantified in monetary terms as far as possible. The estimation of costs and benefits for the different restoration targets is based on available evidence in scientific literature on the key costs and benefits of the different measures that can or must be taken to achieve the restoration target. References to these sources of evidence are provided in the supporting thematic assessments. The analysis is thus not based on any particular simulation or predictive model.

Quantitative Assessment: The cost analysis involved estimating the areas of each ecosystem requiring restoration, re-creation and maintenance, taking into account a baseline assessment of pressures, planned environmental actions and other drivers of change to 2030. The areas requiring restoration, re-creation and maintenance were then multiplied by an appropriate unit cost per hectare. The unit costs employed were based on a review of EU wide evidence on ecosystem management costs. The most comprehensive source of data was the study of the costs of implementing Target 2 of the EU Biodiversity Strategy (Tucker, et al, 2013)[16] which formed the basis of the costings for many of the targets. The costings assumed that all degraded ecosystems would require annual maintenance from 2022, to prevent further degradation, and that restoration and re-creation action would be phased over the period 2022-2050 in line with the targets for 2030, 2040 and 2050.

All costs were expressed in EURO at 2020 prices. Opportunity costs relating to land management practices are included where the per hectare costs include payments for income forgone (e.g. reduced agricultural yields from meeting ecosystem restoration objectives). However, the opportunity costs of potential development/land use change are not included. Administrative costs are estimated separately under the enabling measures.

The benefits assessment valued the benefits of ecosystem restoration by estimating the cumulative area of each ecosystem restored/ re-created and applying a best estimate of the

[16] Tucker, Graham; Underwood, Evelyn; Farmer, Andrew; Scalera, Riccardo; Dickie, Ian; McConville, Andrew; van Vliet, Wilbert. (2013) Estimation of the financing needs to implement Target 2 of the EU Biodiversity Strategy. Report to the European Commission. Institute for European Environmental Policy, London. https://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/Fin%20Target%202.pdf

value of benefits per hectare. The unit benefits estimates were derived from a wide-ranging evidence review of the benefits of ecosystem restoration for each ecosystem type. This selected representative estimates of the value of ecosystem service benefits resulting from ecosystem restoration. For most ecosystems it was possible to identify two unit values, one for the value of carbon storage/sequestration benefits and one for increases in total ecosystem service values. In each case the analysis used the median value per hectare from the range of estimates available, converted where necessary to EURO and updated to 2020 prices.

Some caution is needed in interpreting these benefits estimates, particularly for those ecosystems (such as coastal wetlands) where values vary widely by location, and the range of available benefits estimates is large. The use of median values gives more conservative estimates than mean values. In general, estimates of carbon benefits are less variable and more certain than those of wider ecosystem service values, because they vary less by geography. For example, the flood management benefits of restoring a wetland vary widely according to its location relative to people and property, while the carbon benefits are more even. For most ecosystems, there are large differences between carbon values and total ecosystem service values, because of the high values of other ecosystem services (e.g. flood management, water purification, recreation and other cultural services) as well as the value of biodiversity itself. In many studies these are combined in overall estimates of the public's willingness to pay for ecosystem restoration and related services. This is especially true of coastal wetlands and freshwaters. Benefit values for carbon alone, where available, provide a conservative estimate of the benefits of ecosystem restoration.

The comparison of benefits and costs estimated the time profile of annual costs and benefits over the period 2022-2070, recognising that restoration and re-creation would take place up to 2050 but that benefits would continue to accrue after 2050. Maintenance costs were estimated for the whole 2022-2070 period. The present value of costs and benefits was calculated by discounting annual values using a social discount rate of 4%. The net present value of benefits (sum of discounted benefits – sum of discounted costs) and benefit/cost ratio (sum of discounted benefits/sum of discounted costs) was calculated in each case.

Ecosystem services and -benefits

Based on an extensive review of literature of the value of benefits of restoration (see summary table below), benefits estimates for each broad ecosystem type were made which identified changes in the values (per hectare) of ecosystem services for restored versus degraded ecosystems. Median values per hectare were taken from per hectare estimates given in different relevant literature sources for carbon storage and sequestration and total ecosystem service values (so including carbon benefits). This provided per hectare benefits estimates for each ecosystem type.

A broad scope was taken to the estimation of total benefits, while avoiding overlaps, to obtain as full a picture of total benefits as possible. The types of benefits accounted for are similar between ecosystems, with some differences mostly caused by differences in services provided between different ecosystems and the scope of available studies on which median estimates were based. However due to the significant number of studies consulted, differences between studies will have levelled out in the final estimates. The table below provides an overview of benefits identified beyond biodiversity and carbon benefits which were assessed for all ecosystem types, as well as the number of studies consulted to obtain a per hectare benefits estimate.

The benefits estimates per hectare were then applied to the area of ecosystem restored to give annual estimates of total benefits. Annual costs and benefits were estimated over the period 2022 -2070, recognising that, while restoration takes place to 2050, further maintenance costs continue beyond that date, while restored ecosystems continue to provide benefits into the future. Annual cost and benefit estimates were discounted, applying a 4% social discount rate, and summed to calculate their total present value. This enabled total net present value (benefits – costs) and benefit: cost ratios to be calculated.

Types of key benefits identified and number of studies used to estimate per hectare benefits

Note: The list of benefits is non-exhaustive and excludes biodiversity conservation and carbon sequestration & storage benefits which were identified and assessed for each ecosystem type.

Ecosystem type/target	Types of benefits identified	Number of studies used to estimate per ha benefits
Inland wetlands	Flood alleviation; water quality improvements; recreation- and other cultural services.	22
Coastal and other saline wetlands	Storm surge mitigation; protection against coastal erosion; water filtration; fish stock restoration; recreation and other cultural services.	13
Forests	Timber products and non-timber forest products, water- and soil quality, flood prevention, increased resilience against natural disturbances (droughts, fires, pests, and diseases); recreation- and other cultural services.	Meta-analysis by De Groot et al (2013), which was based on 58 source studies
Agro-ecosystems	Food and fibre; water quality; flood management; pollination; soil quality; erosion control; climate regulation; cultural services (recreation, landscape, aesthetic values).	>50
Steppe, heath and scrubland	Erosion control; water quality; flood management; fire prevention; food and fibre; cultural services (recreation, landscape and existence values).	15
Rivers, lakes and alluvial habitats	Fresh water; fisheries; genetic resources; waste treatment; water quality; flood management; soil quality; cultural services (landscape, aesthetic, inspirational and recreational).	>30 Total ecosystem service benefits of river and lake restoration from de Groot et al (2020). Bankside ecosystems based on analyses for grassland and forest ecosystems.
Marine ecosystems	Flood mitigation, erosion control, water quality, food and fibre (including indirectly through fish stock regeneration), recreational services.	No full quantified benefits estimate could be made because of data gaps, but the assessment identified monetised benefits for 3 out of 8 key habitat types

		in focus (seagrass beds, kelp & macro-algal forests, and shellfish beds).
Urban ecosystems	Health and wellbeing; cooling and insulation (e.g. against urban heat island effect); recreation; food- and fibre; flood risk reduction; water quality; air quality, noise reduction, property value.	No full quantified benefits estimate could be made because of data gaps and large contextual differences. However the assessment identified a range of qualitative benefits and positive cost-benefit ratios from EU-wide and regional/local studies on urban tree and -green spaces limiting on a narrow set of benefits only (e.g. urban heat island effect).
Soil ecosystems	Water quality; flood risk mitigation; drought risk mitigation; pest control; reduced input costs; soil subsistence and -degradation prevention (and herewith resilience of food- and fibre).	No full quantified benefits estimate could be made because of data gaps, but the assessment identified and described qualitatively a wide range of benefits and various examples of positive cost-benefit ratios.
Pollinators	Sustainable provision of animal-pollinated crops and associated benefits; healthy ecosystems dependent on the diversity of wild animal-pollinated plants (and wide-range of regulating ecosystems based on them); cultural, aesthetic, wellbeing.	No full quantified benefits estimate could be made because of data gaps, but the assessment identified and described qualitatively a range of benefits to stakeholders.

Risks that potentially limit the benefits of ecosystem restoration

There are a range of risks that the estimated benefits will not be realized. These risks are listed in the table below.

Type of risk	**Consequence**	**Mitigation**
Implementation risk – targets are not implemented as specified	Failure to implement the targets will mean that full benefits of restoration will not be realised. Costs will also be reduced, so benefit cost ratios should still be favourable.	Accompanying measures – communications, guidance, incentives – will be required to support implementation. Legal enforcement measures can be applied if necessary. The B:C analysis assumes that only 90% of ecosystems will in practice be restored by 2050.
Technical risk – restoration actions fail to achieve target condition, because of scientific uncertainties; failure to undertake appropriate actions; adverse effects of climate, pollution, invasive species etc.	Failure to restore ecosystem to good condition will mean that anticipated benefits for biodiversity and ecosystems are not realised. Costs will still be incurred, and may exceed benefits.	Knowledge sharing, provision of advice, guidance and technical support, monitoring and adaptive actions can help to reduce risk
Ecosystem service risk – even if ecosystems are restored to good condition, they may not deliver anticipated benefits to people – e.g. because benefits occur in places remote from people and property	Locational factors may mean that the value of benefits may be less than anticipated – e.g. few recreational visitors are attracted, water is purified in places where it is not consumed, flooding is reduced in areas of low population; biodiversity and	Locational variations in benefits need to be understood. Benefits assessment has applied median values, which is more conservative than applying mean or maximum values.

	global climate benefits may still be realised.	
Temporal risks – risk that delays in achieving good ecosystem condition and associated enhancements in ecosystem services will reduce the overall value of benefits delivered.	Costs are normally incurred before benefits are realised. Time preference means that delays in securing benefits will reduce the present value of benefits, and may cause them to be outweighed by costs.	Linked to mitigation of technical risks, as above. Prioritising restoration of ecosystems that take longest to recover (e.g. woodland and species rich grasslands) increases the probability of benefits being delivered within a specified timescale.
Financial risks – even if benefits are fully realised, additional costs of restoration may impact B:C ratios	Higher than anticipated costs could mean benefits exceed costs in some locations	Linked to mitigation of technical risks, as above. Understanding variations in costs and benefits, and reflecting this in restoration plans, is important.

Overall, these risks are significant, particularly because of the range of scientific uncertainties, locational variations and environmental factors that influence the effectiveness of ecosystem restoration and its benefits and costs. However, they can be mitigated through application and sharing of best available evidence; a robust approach to restoration planning; guidance, technical support and skills development; and monitoring and adaptive management. **The high benefit:cost ratios estimated for each ecosystem type, with benefit:cost ratios ranging from 4:1 to 38:1, leave a sufficient margin to ensure that ecosystem restoration will be efficient even if benefits are less than anticipated.**

Although in theory the EU should aim to restore all degraded ecosystems by 2050, and targets should align with this goal, **in practice complete implementation is unlikely to be achievable.** Some sites may be inaccessible, face insurmountable technical barriers to restoration, be adversely affected by external pressures such as pollution, be earmarked for changes in land use, or be subject to disputes between land owners, managers and the authorities. If full implementation is not achieved, there will be a reduction in costs as well as benefits, such that benefit:cost ratios will still be favourable. The analysis for the impact assessment assumed that **restoring 90% of degraded ecosystems could be regarded as a realistic level of full implementation.** The benefit: cost analyses are therefore based on a 90% restoration target by 2050.

A failure to restore 90% of the area of degraded ecosystems by 2050 would reduce both the benefits and costs of ecosystem restoration. The table below estimates the present value of the benefits and costs of restoration of different ecosystem types, based on achievement of 90% restoration by 2050, and if lower (70% or 80%) rates of restoration are achieved.

Benefits and costs of achieving different levels of restoration by 2050, Scenario A (Present Value, EUR million)

	90% restoration by 2050			80% restoration by 2050			70% restoration by 2050		
Restoration of ecosystem type	**Benefits**	**Costs**	**Net Benefits**	**Benefits**	**Costs**	**Net Benefits**	**Benefits**	**Costs**	**Net Benefits**
Peatlands	38 702	4 779	**33 923**	34 402	4 248	**30 154**	30 102	3 717	**26 385**
Marshlands	6 388	3 643	**2 745**	5 678	3 238	**2 440**	4 968	2 833	**2 135**
Coastal wetlands	181 614	5 141	**176 473**	161 435	4 570	**156 865**	141 255	3 999	**137 257**
Forests	203 564	50 082	**153 482**	180 946	44 518	**136 428**	158 328	38 953	**119 375**
Agro-ecosystems	229 589	26 559	**203 030**	204 079	23 608	**180 471**	178 569	20 657	**157 912**
Steppe, heath and scrub	32 658	9 198	23 460	29 029	8 176	20 853	25 401	7 154	**18 247**
Rivers, lakes and alluvial habitats	862 349	35 232	**827 117**	766 532	31 317	**735 215**	670 716	27 403	**643 313**
Subtotal	**1 554 864**	**134 634**	**1 420 230**	**1 382 101**	**119 675**	**1 262 426**	**1 209 339**	**104 716**	**1 104 623**

The present value of the quantified net benefits is estimated to total €1,418 billion if 90% of these ecosystems are restored by 2050, but would fall to €1,260 billion if only 80% of ecosystem area were restored, or €1,102 billion if only 70% ecosystem restoration were achieved.

The costs of ecosystem restoration are incurred immediately, while the benefits for biodiversity and ecosystem services are realised only when restored ecosystems reach good condition. Evidence indicates that **the time profile of benefits is non-linear and varies between ecosystems**, with some habitats being easier and quicker to restore than others. For example a review by Maskell et al (2014)[17] found that some freshwater wetlands can be effectively restored within five years, but may take longer to regain their full biodiversity. Other habitats such as calcareous grasslands and some woodlands may take more than 100 years to be restored to their full biodiversity value. Within each habitat, some aspects of ecosystem functioning and services are likely to return before others. For example, restoration of blanket bog may achieve improvements in hydrology, carbon storage and even recolonization of vegetation within three years, but may take 20-50 years to restore full vegetation communities. It follows that some ecosystem services may be enhanced immediately while others will take longer to recover. The benefits analysis for this impact assessment estimates the present value of future flows of benefits; however, this is inevitably subject to a range of uncertainties.

Impacts on areas surrounded by ecosystems in which restoration measures are taken

[17] Maskell L, Jarvis S, Jones L, Garbutt A and Dickie I (2014) Restoration of natural capital: review of evidence. Report to the Natural Capital Committee, UK. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/517024/ncc-research-restoration-natural-capital-review.pdf

The assessment did not quantify indirect costs of restoration measures that could be occurred in areas outside of ecosystem areas in which measures would be taken. The reason for this was that such ‘external’ negative impacts of measures identified would likely be relatively limited.

One possibly more significant indirect impact identified was that of rewetting of inland wetlands on neighbouring areas under intensive arable- or grazing agriculture. These impacts would be similar as those assessed for inland Annex I habitats, and would require different management practices by private landowners and land managers, in return for incentive payments which include compensation for opportunity costs relating directly to land management (e.g. income forgone through reduced yield or grazing). As explained in Annex III, such practices and incentive schemes are in place, as well as public budgets to support their increased uptake.

The rewetting of inland wetlands could locally present significant indirect opportunity costs for agriculture in some areas, especially in small wetland sites surrounded by intensive agriculture where mitigation measures to avoid seepage are not in place. However their inclusion in the cost-benefit analysis would unlikely have made a significant difference on the overall cost estimate. This is because they represent only a small share of the total area of inland wetland ecosystem considered in the assessment.

Considering the very positive benefit to cost ratios of nature restoration across the different ecosystem types, even if external costs excluded would nonetheless significant, they would likely still be (far) outweighed by larger benefits and would not have changed the overall findings of the assessment. Inland wetland rewetting for example could also have positive impacts on water availability for agriculture during droughts likely to increase with climate change in most regions.

Opportunity costs: Opportunity costs of implementing the nature restoration targets were considered for all thematic assessments and included in calculations to some extent. Any effort to restore nature comes with an opportunity cost to certain alternative development pathways, particularly at local level. However, because of the many potential alternatives it is impossible to provide a full and systematic assessment, taking account of overall effects, especially as one would also need to consider the opportunity cost of not restoring ecosystems. Instead, the assessments focussed only on the most significant costs of restoration measures in the field that would be required by economic operators such as farmers, foresters and fishermen.

Ecosystem restoration that requires voluntary action will not be achieved unless adequate compensation for opportunity costs is provided since economic operators will not restore ecosystems if the payments to do so do not compensate them for opportunity costs of reduced production. Where the costs of ecosystem restoration are met through incentive payments to land managers, the latter are compensated for opportunity costs (payment for income forgone). Under EU agricultural policy, these incentives are already in place in the form of agri-environment-climate schemes and -investments, which could be made more attractive to farmers with supplementary eco-schemes. Therefore, the additional opportunity costs of new nature restoration targets will largely be accounted for if available budgets and tools are used effectively. Opportunity costs of land use change due to re-creation were not included in the cost calculations, since a large share of habitat can be re-created on land that already has a nature function and this would mainly require a higher restoration effort compared to habitat that still meets Annex I standards. Where land would change owner and/or function, this is nearly in all cases the result of voluntary selling or abandoning of land and was therefore not regarded as an opportunity cost to operations.

The cost estimates in the thematic ecosystem assessments therefore include direct opportunity costs resulting from changes in land management practices, and reflected in incentive payments to land managers. Examples include income forgone from reduced grazing intensity on heathland, wetland and grassland ecosystems; creation of new habitats such as wetlands, heathlands, forests and grasslands through conversion of cropland and pasture land; reduced timber harvest from forests; and restrictions on fishing activity in coastal wetlands. In each case these are incorporated in per hectare unit costs of ecosystem restoration, re-creation and maintenance.

Only in a few thematic impact assessments uncompensated opportunity costs were identified in cases where nature restoration would be mandated through bans rather than incentives. These mainly include rules limiting fishing effort and rules preventing soil sealing in cities. Estimating these costs is difficult since rules lead to adaptive management and often deliver more efficient solutions in the longer term. For example, evidence shows how partial restrictions in fishing efforts in marine protected areas have triggered more efficient fisheries management and enhanced longer-term yields and overall ecosystem health around these areas. Under the EMFAF, the structural fund; that supports the implementation of the CFP, resources are available to compensate for short-term losses due to reduced catches and support investments in e.g. adaptive and more selective fishing gears and techniques or scientifc research. For the restoration of estuaries and mud- & sandflats, nonetheless specific costs were included to phase out the most harmful (shell)fishing practices from Annex I habitats, based on experiences in the Wadden Sea.

Uncompensated opportunity costs were also identified in the urban thematic assessment and for target options to prevent soil sealing and increase urban tree cover. Implementing these targets would require very different choices in land use in urban areas, with potentially very high costs (and benefits) depending on the location and alternative land use. These costs and benefits can be expected to vary very widely across urban areas in the EU, given the wide variations in the scale, density, format and design of urban areas between countries and regions, as well as differences in land prices and development patterns. Assessing the overall costs and benefits of land use change across the entire urban environment is too complex and impossible with the current evidence base, and therefore not quantified in the assessment.

Qualitative assessment: For the thematic assessments for marine-, urban- and soil ecosystems and pollinators, full monetary assessments could be not developed at the same level as for assessments underpinned by detailed data on the extent and condition of Annex I habitats. Nonetheless the assessments could make informed qualitative assessments based on extensive meta- and case study evidence describing costs and benefits both on biodiversity as well as range of ecosystem services including climate action. Some of this evidence included quantified cost-benefit data too. For example, in the marine environment the relatively limited number of available studies on restoration cost-benefit-analysis suggested that restoring marine habitats record an average benefit-cost ratio of 10, comparable to ratios found in the more detailed assessments for terrestrial habitats. Similarly, while little quantified evidence was available to assess the additional benefits of restoration action for soils and pollinator populations, even conservative estimates of total benefits are so high that even a relatively limited improvement in condition would compare favourably against the estimated cost of restoration measures to implement the target options. In the urban environment, available monetised evidence of benefits of restoration e.g. by tree cover reducing heat island effects is arguably the most extensive and overwhelming, even though biodiversity and climate mitigation benefits would be more limited. In summary, the absence of aggregated monetary cost and benefit calculations for four of the thematic assessments has a methodological reason and should not be misinterpreted as meaning that target options assessed in them would therefore stand out less positively in terms of their net benefit to EU policy objectives.

Annex V: Specific targets considered for the main ecosystem types

For targets in step 1 marked with (*) it is likely that finalising the measurement methodology and establishing a baseline would be ready by 2023. Given that negotiations with Parliament and Council on the proposal would last until at least mid-2023, these could be in principle included in the legislative proposal.

Targets in step 2 are indicative. Further targets, not listed here may also be considered for step 2.

<table>
<tr><th colspan="2">POTENTIAL TARGETS AND OBLIGATIONS</th></tr>
<tr><th>STEP 1</th><th>STEP 2</th></tr>
<tr><td colspan="2">WETLANDS (incl. Peatlands, marshlands & coastal wetlands)</td></tr>
<tr><td>• Restore all HD Annex I wetland habitat area to good condition, with all necessary restoration measures completed on 30 % (or 15 %) of degraded areas by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050[18].
• Recreate 30 % (or 15 %) of additional habitat area required to achieve favorable conservation status of HD Annex I wetland habitats by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
• Restore and re-create the area as necessary to enhance the conservation status of species listed in Annex II, IV and V of the Habitats Directive as well as wild birds associated with wetlands in view of achieving their favourable conservation status by 2050, with at least 30 % achieved by 2030 and at least 60 % by 2040[19].</td><td></td></tr>
<tr><td colspan="2">Target option discarded as a result of the Impact Assessment (explanation in annex VI):
• General habitat restoration and re-creation of marshlands
• Recreate salt marshes (excluded as specific targets as largely covered under HD Annex I target).
• Phasing out bottom-disturbing (shell-)fishing in Natura 2000 sites.</td></tr>
<tr><td colspan="2">FORESTS</td></tr>
<tr><td>• Restore all HD Annex I forest habitat area to good condition, with all necessary restoration measures completed on 30 % (or 15 %) of degraded areas by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
• Recreate 30 % (or 15 %) of additional habitat area required to achieve favorable conservation status of HD Annex I forest habitats by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
• Restore and re-create the area as necessary to enhance the conservation status of species listed in Annex II, IV and V of the Habitats Directive as well as wild birds associated with forests in view of achieving their favourable conservation status by 2050, with at least 30 % achieved by 2030 and at least 60 % by 2040.
• Achieve a continuously improving trend of each of the following indicators, until satisfactory levels are achieved or until new</td><td>Restore degraded non-HD Annex I forest habitat areas.</td></tr>
</table>

[18] The percentages between brackets represent an alternative (slower) rate of restoration. See explanation in section 6.3.

[19] As peatland species are well covered as regards their habitat, this target focuses particularly on species of marshlands and coastal wetlands.

<table>
<tr><th colspan="2">POTENTIAL TARGETS AND OBLIGATIONS</th></tr>
<tr><th>STEP 1</th><th>STEP 2</th></tr>
<tr><td>targets are in place: deadwood, age structure, forest connectivity, tree cover density, abundance of common forest birds, soil organic carbon in forest land.</td><td></td></tr>
<tr><td colspan="2">AGRO-ECOSYSTEMS AND GRASSLANDS</td></tr>
<tr><td>

Restore all HD Annex I agricultural habitat area to good condition, with all necessary restoration measures completed on 30 % (or 15 %) of degraded areas by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
Recreate 30 % (or 15 %) of additional habitat area required to achieve favorable conservation status of HD Annex I agricultural habitats by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
To increase the populations of farmland birds as measured by the common farmland bird index re-set at 100 at year X [one year after the entry into force of this Regulation] to:

110 by 2030, 120 by 2040 and 130 by 2050, for Member States with historically depleted populations of farmland birds;
105 by 2030, 110 by 2040 and 115 by 2050, for Member States that do not have historically depleted populations of farmland birds.

Restore and re-create the area as necessary to enhance the conservation status of species listed in Annex II, IV and V of the Habitats Directive as well as wild birds associated with agro-habitats and grassland in view of achieving their favourable conservation status by 2050, with at least 15 %/30 % of all necessary actions carried out by 2030 and 40 %/60 % by 2040 and 100 % 2050.
For drained peatlands under agricultural use, to put in place restoration measures, including rewetting, on at least:

30% of such areas by 2030 of which at least a quarter is rewetted;
50% of such areas by 2040 of which at least half is rewetted, and
70% of such areas by 2050 of which at least half is rewetted.

Achieve a continuously improving trend of each of the following indicators:

grassland butterfly index;
organic carbon content in cropland mineral soils;

until satisfactory levels are achieved or until the new targets are in place; and

share of agricultural land with high-diversity landscape features until 2030, with the view to achieving the EU commitment to bring back at least 10% of agricultural area under high-diversity landscape features by 2030;
percentage of species and habitats of Union interest related to agriculture with stable or increasing trends until 100% is reached at the latest by 2050.

</td><td>

Restore and recreate semi-modified and semi-natural grasslands.
Restore and recreate unploughed / untilled grasslands.

</td></tr>
<tr><td colspan="2">Target option discarded as a result of the Impact Assessment (explanation in annex VI):
• Increasing landscape features in the farming landscape to a minimum coverage of 10 %.</td></tr>
<tr><td colspan="2">STEPPE, HEATHLANDS & SCRUB, DUNES AND ROCKY HABITATS</td></tr>
<tr><td>

Restore all HD Annex I steppe, heath and scrub, dunes and rocky habitat area to good condition, with all necessary restoration measures completed on 30 % (or 15 %) of degraded areas by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
Recreate 30 % (or 15 %) of additional habitat area required to achieve favorable conservation status of HD Annex I steppe, heath

</td><td></td></tr>
</table>

<table>
<tr><th colspan="2">POTENTIAL TARGETS AND OBLIGATIONS</th></tr>
<tr><th>STEP 1</th><th>STEP 2</th></tr>
<tr><td>and scrub, dunes and rocky habitats by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
• Restore and re-create the area as necessary to enhance the conservation status of species listed in Annex II, IV and V of the Habitats Directive as well as wild birds and associated with steppe, heath and scrub, dunes and rocky habitats in view of achieving their favourable conservation status by 2050, with at least 30 % (or 15 %) of all necessary actions carried out by 2030 and 60 % (or 40 %) by 2040 and 100 % by 2050.</td><td></td></tr>
<tr><td colspan="2">FRESHWATER: RIVERS, LAKES AND ALLUVIAL HABITATS</td></tr>
<tr><td>• Restore all HD Annex I rivers, lakes and alluvial habitat area to good condition, with all necessary restoration measures completed on 30 % (or 15 %) of degraded areas by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
• Recreate 30 % (or 15 %) of additional habitat area required to achieve favourable conservation status of HD Annex I rivers, lakes and alluvial habitats by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
• Restore and re-create the area as necessary to enhance the conservation status of species listed in Annex II, IV and V of the Habitats Directive as well as wild birds associated with rivers, lakes and alluvial habitats in view of achieving their favourable conservation status by 2050, with at least 15 % achieved by 2030 and at least 40 % by 2040.
• Develop an inventory of barriers to longitudinal and lateral connectivity of rivers and a detailed plan of which barriers will be removed, with a view to achieving free-flowing status where possible and necessary to restore the habitats depending on such connectivity.
• Mapping out of small water units, with a view to identify their restoration and recreation potential and assess their contribution to improve connectivity between habitats as part of high diversity landscape features, contributing to the restoration of habitats and species.</td><td>• Numerical target on the restoration of free flowing rivers.[20]
• Restoration of small water units.</td></tr>
<tr><td colspan="2">Target option discarded as a result of the Impact Assessment (explanation in annex VI):
• Implement standardised ecological flow assessments.</td></tr>
<tr><td colspan="2">MARINE ECOSYSTEMS</td></tr>
<tr><td>•
• To put in place the necessary restoration measures to improve all areas that are not in good condition to good condition in specified marine habitat types, with measures put in place on at least 30 % of such areas by 2030, on at least 60 % of such areas by 2040, and on at least 90 % of such areas by 2050[21]:
a. HD Annex I marine habitats (sub-types of Annex I habitat types, such as seagrass beds, macro-algal forests, sponge, coral and coralligenous beds, maerl beds, shellfish beds, vents and seeps);</td><td>• Target on specific marine animal species.</td></tr>
</table>

[20] This is related to the target in step 1 which requires Member States to develop inventories of barriers to longitudinal and lateral connectivity of rivers and a detailed plan of which barriers will be removed, with a view to achieving free-flowing status where possible and necessary to restore the habitats depending on such connectivity. This will contribute to achieving the voluntary target of the BDS2030 of 25 000 km of free flowing rivers. As part of step 2, a more exact approach to setting a numerical target on free-flowing rivers, including lateral and longitudinal aspects, would be developed.

[21] It is important to bear in mind the long time periods to restore certain marine ecosystems, thus this proposed target is based on putting necessary measures into place by 2030 and with the aim of arriving at good condition beyond 2030.

<table>
<tr><th colspan="2">POTENTIAL TARGETS AND OBLIGATIONS</th></tr>
<tr><th>STEP 1</th><th>STEP 2</th></tr>
<tr><td>b. Marine habitats outside HD Annex I (such as marine shelf sediments).
• To put in place the restoration measures necessary to re-establish those habitat types on at least 30 % of the additional area needed to reach the favourable reference area of each group of habitat types by 2030, at least 60 % of such areas by 2040, and 100 % of such areas by 2050;
• To put in place restoration measures for the habitats of marine species listed in Annexes II, IV and V of the HD and Annex I to Regulation 2019/1241 and of wild birds covered under Birds Directive, that are needed to improve the quality of those habitats, re-establish those habitats and create sufficient connectivity among those habitats corresponding to the ecological requirements of those species.</td><td></td></tr>
<tr><td colspan="2">Targets discarded as a result of the Impact Assessment (explanation in Annex VI):
• To restore habitats in order to maximise the delivery of key ecosystem services.
• Restore and re-create the area as necessary to enhance the conservation status of species listed in Annex II, IV and V of the Habitats Directive as well as wild birds associated with marine ecosystems in view of achieving their favourable conservation status by 2050, with at least x % achieved by 2030 and at least y % by 2040.</td></tr>
<tr><td colspan="2">URBAN ECOSYSTEMS</td></tr>
<tr><td>• To ensure that there is no net loss of urban green space, and urban tree canopy cover by 2030, compared to 2021, within all cities and towns and suburbs;
• To ensure that there is an increase in the total national area of urban green space in cities and towns and suburbs of at least 3 % of the total area of cities and towns and suburbs in 2021, by 2040, and at least 5 % by 2050. In addition Member States shall ensure:
i. a minimum of 10 % urban tree canopy cover in all cities and towns and suburbs by 2050; and
ii. a net gain of urban green space that is integrated into existing and new buildings and infrastructure developments, including through renovations and renewals, in all cities and towns and suburbs.</td><td></td></tr>
<tr><td colspan="2">Targets discarded as a result of the Impact Assessment (explanation in Annex VI):
• No net soil sealing in Functional Urban Areas by 2030.</td></tr>
<tr><td colspan="2">POLLINATORS</td></tr>
<tr><td>• Reverse the decline of pollinators (*): This target relates in particular to the following ecosystems: agro-habitats and grasslands, wetlands, forests and heathlands & scrub.</td><td></td></tr>
<tr><td colspan="2">Targets discarded as a result of the Impact Assessment (explanation in Annex VI):
• To achieve good condition of pollinator species protected by the EU Habitats Directive.
• To achieve good condition of pollinator habitats protected by the EU Habitats Directive.</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">An EU wide methodology for assessing the condition of ecosystems would be established.</td></tr>
</table>

Annex VI: Analysis by ecosystem

This (large) annex is provided as a separate file. It provides input to Chapter 6 on policy option 3.

Annex VII: Description, trends and impacts of the main options

This annex mainly serves as input for Chapter 6 on policy options 1 (baseline) and 2 (overarching goal).

1 BASELINE

This chapter describes, based on monitoring evidence on the state of ecosystems, previous experience in restoration governance and expert judgement, the likely evolution of ecosystems' condition and nature restoration developments in the EU towards 2030 (and to some extent 2040 and 2050) *in the absence of legally binding EU nature restoration targets*. To forecast the likely evolution and impacts of this baseline scenario is necessary so that these can be compared against the impacts of the different additional policy options (including targets) considered in Chapter 5.

The EU had set itself a voluntary nature restoration target between 2011 and 2020 and is implementing several pieces of environmental legislation that contribute to nature restoration as part of meeting specific ecological objectives; in particular these include the implementation of the EU Birds and Habitats Directives, the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD) and existing climate laws. In addition, some EU Member States have additional national policies and strategies requiring nature restoration. Lastly, the EU Green Deal and initiatives such as the EU Biodiversity Strategy to 2030 include a series of new commitments that would also contribute to nature restoration, in a direct or in an indirect manner. Reporting data and recent evaluations of the state of implementation of these activities to date provide a key source for this baseline assessment. It is important to underline that in the baseline scenario, “implementation” of relevant policies, voluntary commitments and legislation is interpreted as “realistic”, i.e. as based on expected implementation by Member States and based on experience to date. This therefore does not interpret this as the full and complete implementation of these policies. This chapter then describes the likely predicted evolution of the baseline scenario for the next decade(s) considering realistic estimates of policy implementation, as well as the likely evolution of biophysical developments, such as for example, based on the predicted effects of climate change.

1.1 EU nature restoration under Business as Usual

1.1.1 Implementation EU Nature Directives, WFD and MSFD

Nature restoration in the EU stems from both voluntary and mandatory commitments, but is mostly driven by EU and national legislation that sets concrete ecological objectives. At EU level, four Directives set such objectives: The EU Birds- and Habitats Directives, the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD). As mentioned in Chapter 3, progress in implementing these four key EU laws in the future contributes to determining the level of additional action required on nature restoration in the EU.

There is good ground to argue that in the period towards 2030 the **Nature Directives** will see enhanced implementation compared to 2010-2020: firstly, the designation of the Natura 2000 network is nearing completion on land, which could free up resources in national and regional administrations towards the management of the sites. Secondly, as mentioned in section 3.1.1, the Nature Directives include specific requirements that Member States should take the necessary conservation measures to ultimately achieve and maintain Favourable Conservation Status of protected habitats and species, which in many cases will include ecological restoration especially in Natura 2000 sites. In recent years significant efforts on developing site-specific objectives- and measures including restoration measures have been made, which is an important prerequisite for the effectiveness of their implementation22. The better articulation of needs in management planning has also supported investment planning, and EU Member States in their Prioritised Action Frameworks for Natura 2000[23] and beyond have communicated much more comprehensively the full investment needs to achieve objectives. This in turn will support the justification for providing such funding under the CAP or Regional Development. However, experience has shown the challenges of providing funding, even in EU Member States in which such needs were clearly articulated[24].

However, as the Nature Directives lack legal deadlines for the achievement of their objectives, an important defining factor in the pace of implementation will be the political ambition to achieve sooner rather than later the Directives' objective to reach Favourable Conservation Status and, obviously, the funding available for the necessary action, including in relation to the necessary investments for strengthening knowledge and administrative capacity.

With the absence of legal deadlines, there would continue to be a weak driver for action to achieve the objectives of the Nature Directives. Furthermore, concerning the Habitats Directive, for Annex I habitats and habitats of Annex II species outside Natura 2000, there is no specific provision on restoration, albeit the achievement of the directive's objective would require this to happen. The same goes for species listed in Annex IV and V of the directive, for which no specific restoration provisions are set, despite the objective to maintain or restore them, at favourable conservation status. The same goes for the Birds Directive which includes some provisions on restoration mainly related to bird species for which Member States are to classify, protect and conserve Special Protection Areas (part of the Natura 2000 network) (species listed in Annex I of the directive as well as regularly occurring migratory species not listed in Annex I). The vast amount of land and sea covered by habitat types and habitats of species of EU importance, including birds, makes it difficult to achieve restoration objectives without explicit legal requirements in areas outside protected areas.

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[22] See for example: EEA (2020) Management effectiveness in the EU's Natura 2000 network of protected areas. Available at: https://www.eea.europa.eu/publications/management-effectiveness-in-the-eus

[23] European Commission webpage on financing Natura 2000: https://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm

[24] See for example Olmeda C. et al for the European Commission (2016) Integration of Natura 2000 and biodiversity into EU funding. Available at: https://ec.europa.eu/environment/nature/natura2000/financing/docs/Natura2000_integration_into_EU %20funds.pdf

For the **Water Framework Directive**, there is some reason to believe that implementation may increase compared to progress between 2010 and 2020. Firstly, in 2027 the Directive's final deadline for extending the achievement of good status of water bodies will be reached, after which it becomes legally more challenging for Member States to push implementation action into the future[25]. Secondly, the Fitness Check of EU Water Legislation has reconfirmed the WFD's added value, uncovered important priorities for improved implementation action, and has provided more legal certainty for the years to come[26]. Nonetheless, early reviews of draft management plans for the WFD's 3rd cycle (2021-2027) suggest that despite some exceptions, foreseen progress on restoration -and towards the WFD's objectives more general- will remain slow due to numerous exemptions and insufficient integration and -investment[27]. While WFD implementation would bring further active passive restoration benefits, they would likely be largely insufficient to restore the structure and function of relevant freshwater, coastal and marine ecosystems required to meet the objectives of the EU Biodiversity Strategy to 2030.

For the **Marine Strategy Framework Directive** implementation may improve towards 2030, however since the Directive has only existed since 2008 it is more challenging to forecast the extent of future improvements. The implementation report on the first management cycle highlighted numerous implementation challenges, and the European Commission has announced a review[28]. Evidence suggests that unless there will be a significant increase in investments, there is little likelihood that implementation will see a very different trajectory than in recent years.

In 2017 the European Commission commissioned a study which included a quantitative assessment of the amount of restoration undertaken in the then EU28 between 2010 and 2017 (Eftec et al)[29] which is currently the best indication available of baseline restoration extent under a situation of a voluntary EU-wide restoration target. The study provided estimates of average **annual EU area** on which restoration action had been taken based on both binding and voluntary commitments and for different ecosystem types. By projecting into the future, the annual area on which restoration action has taken place as estimated by Eftec et al, it is

[25] European Commission (2019) COM(2019) 95 final on the implementation of the Water Framework Directive (2000/60/EC) and the Floods Directive (2007/60/EC). Second River Basin Management Plans and First Flood Risk Management Plans. Available at: https://ec.europa.eu/environment/water/water-framework/impl_reports.htm

[26] European Commission (2019) SWD(2019) 439 final on the Fitness Check of the Fitness Check of the Water Framework Directive, Groundwater Directive, Environmental Quality Standards Directive and Floods Directive. Available at: https://ec.europa.eu/environment/water/fitness_check_of_the_eu_water_legislation/index_en.htm

[27] E.g. Schmidt G. & Rogger M. for Living Rivers Europe (2021) The final sprint for Europe's rivers. Available at: https://wwfeu.awsassets.panda.org/downloads/wwf_the_final_sprint_for_rivers_full_report_june_2021_1.pdf

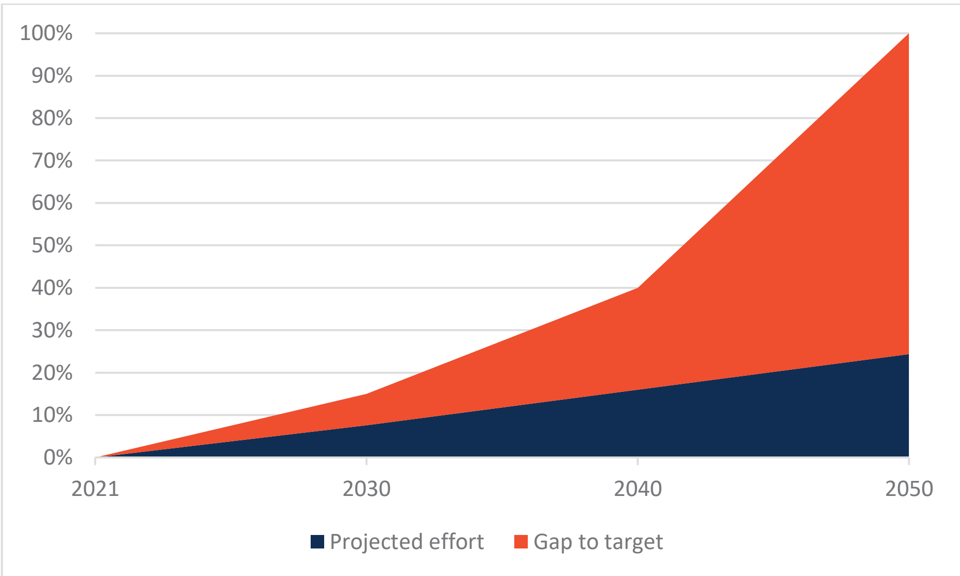
[28] European Commission press release of 25 June 2020 'More protection for our seas and oceans is needed, report finds'. Available at: https://ec.europa.eu/environment/news/more-protection-our-seas-and-oceans-needed-report-finds-2020-06-25_en

[29] eftec et al., (2017) Technical support in relation to the promotion of ecosystem restoration in the context of the EU Biodiversity Strategy to 2020. Available at: https://ec.europa.eu/environment/nature/pdf/promotion_of_ecosystem_restoration_in_the_context_of_the_EU_biodiversity_strategy_report%20.zip

possible to extrapolate the extent of ecosystems that – at the same pace and the same relative effort per ecosystem – would see restoration action in the future. **This extrapolation shows that restoration measures would only reach a fraction of total ecosystem extent, or 0,71% by 2030, 1,50% by 2040 and 2,30% by 2050.** When only **considering only the binding share** of restoration action extent found by Eftec et al, which are the ones most likely to actually deliver on biodiversity conservation objectives, **these shares are only 0,31%, 066% and 1,01%** respectively. When comparing the binding restoration extent against the best estimate of degraded area of Annex I habitat, action would cover less than 2% by 2030, 4% by 2040 and 6% by 2050. As Figure VII-1 shows, even if assuming the Eftec study had only identified 25% of the actual restoration action undertaken and all real action would have been fully targeted to Annex I habitats, there would still be a significant remaining effort gap of more than 75% by 2050. The ecosystem-specific Impact Assessments supporting this overall assessment provide more detailed baseline information per ecosystem (see executive summaries in Annex VI).

Figure VII-1: Projected restoration effort (extent) based on Eftec et al and remaining gap to 15-40-100% HD Annex I targets

Note: This figure assumes that Eftec et all only identified 25% of actual restoration action in the then EU28, and the total effort towards the targets reflects the best-estimate total area of degraded Annex I habitats in the EU27 based on the last conservation status reporting under the EU Habitats Directive (Art 17 reporting)[30].



1.2. Socio-economic developments

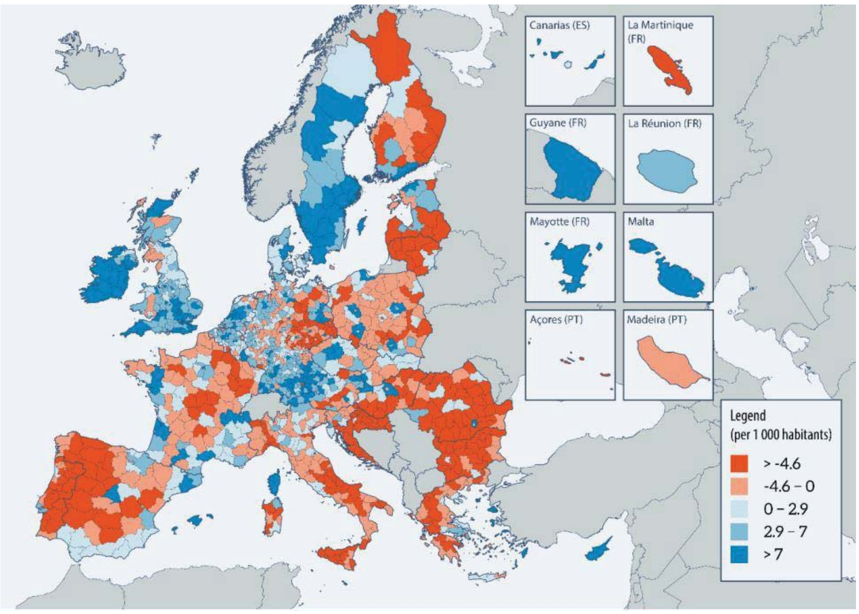
1.2.1. Demographic trends

For the period to 2030 no major changes in demographic trends are foreseen compared to today. Population growth is slowing, but the EU population is still expected to grow to 2030 and likely to 2050, after which it will gradually shrink. Further ageing and depopulation will continue to

[30] Available at: https://www.eea.europa.eu/themes/biodiversity/state-of-nature-in-the-eu/explore-nature-reporting-data

impact on rural areas across the EU, while urban areas are expected to continue to see new population growth. Both urban and rural areas offer different opportunities and challenges for nature restoration depending on the regional context. The ongoing rural exodus will further increase pressure in many regions on the conservation of high-nature value farmland as traditional land management practices disappear. In other regions, land abandonment will offer opportunities for natural vegetation to recover with limited 're-wilding' management. The share of population living in cities will continue to grow from approximately 75 % today to nearly 84 % by 2050[31].

Figure VII-2: Crude rate of total population change in NUTS 3 regions, 2018



Source: Eurostat

1.2.2. Post-COVID recovery

The impacts of the COVID crisis on the EU economy should not be underestimated and may depress the priority given by EU Member States to environmental policy objectives as happened after the European sovereign debt crisis. However, based on expert evidence available when writing this study[32][33], thanks to more decisive public policy and -fiscal measures, the economic outlook is slightly more optimistic than previously envisioned, and growth and employment are expected to recover to pre-crisis levels in 2022. However, these predictions come with significant uncertainties as well as differences between different EU Member States and regions.

[31] UN Department of Economic and Social Affairs (2018) 2018 Revision of World Urbanization Prospects. Available at: https://population.un.org/wup/

[32] European Commission Spring 2021 Economic Forecast: https://ec.europa.eu/info/business-economy-euro/economic-performance-and-forecasts/economic-forecasts/spring-2021-economic-forecast_en

[33] OECD (2021) EA and EU Economic Snapshot - Economic Forecast Summary (May 2021). Part of OECD Global Economic Outlook. Available at: https://www.oecd.org/economy/euro-area-and-european-union-economic-snapshot/

1.3. Expected trends in ecosystem extent and condition

1.3.1. Ecosystem extent

Based on trends over the last decade and foreseen trends in key land use defining indicators[34], we do not expect major changes in ecosystem extent in comparison to the current situation. We therefore did not make any adjustments in our baseline scenario in changes of extent.

1.3.2. Cross-cutting pressures & threats

As explained in section 2.2, because of the diversity in ecosystem types in the EU and differences in what constitutes their good condition, an ecosystem-specific approach was taken to assessing impacts for this study. This included in depth evaluation of key pressures and threats preventing recovery today and into the future as well as their drivers, which are at the root of ongoing ecosystem degradation and risk undermining future restoration efforts. The outcomes of these detailed analyses can be found in the ecosystem-specific technical supplements. Brief summaries of these analyses are included in Annex VI. An important source of EU-wide information on pressures on ecosystems is the reporting under the EU Habitats and Birds Directives. Under the latest reporting round, Member States reported over 67 000 individual pressures in over 200 different pressure categories. The results show that agriculture remains the most common pressure and threat on species and habitats, followed by urbanisation, forestry and the modification of water regimes.

The impacts of climate change on ecosystems are rising, are increasingly understood and reported. The EU Ecosystem Assessment[35] succinctly describes the known estimated potential impacts, which are mainly driven through changing temperature and precipitation patterns. In most parts of Europe, drought frequency will increase (Figure VII-3), heavy precipitation events will increase in winter across Europe and in northern Europe in summers too (Figure VII-4). Longer fire seasons and periods of precipitation shortages will significantly increase the risk of forest fires, also in regions where it has not been a nature feature of local forest ecosystems (Figure VII-5). While these changes in trends are increasing at a relatively slow pace compared to some other more direct anthropogenic pressures, recent evidence shows they are accelerating and will be an important factor in restoration success towards 2030 and certainly 2040 and 2050.

[34] For example, in relation to food and farming, see: European Commission (2021) EU agricultural outlook for markets, income and environment. Available at: https://ec.europa.eu/info/sites/default/files/food-farming-fisheries/farming/documents/agricultural-outlook-2020-report_en.pdf

[35] Section 4.1 of the chapter on cross-cutting ecosystem assessments deals specifically with climate change. Maes, J et al (2020) Mapping and Assessment of Ecosystems and their Services: An EU ecosystem assessment. Available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC120383

Figure VII-3: Projected change in meteorological drought frequency between the present (1981-2010) and the mid-century 21st century (2041-2070) in Europe, under two emissions scenarios (RCP4.5 and RCP8.5) Source: EEA, 2019[36]

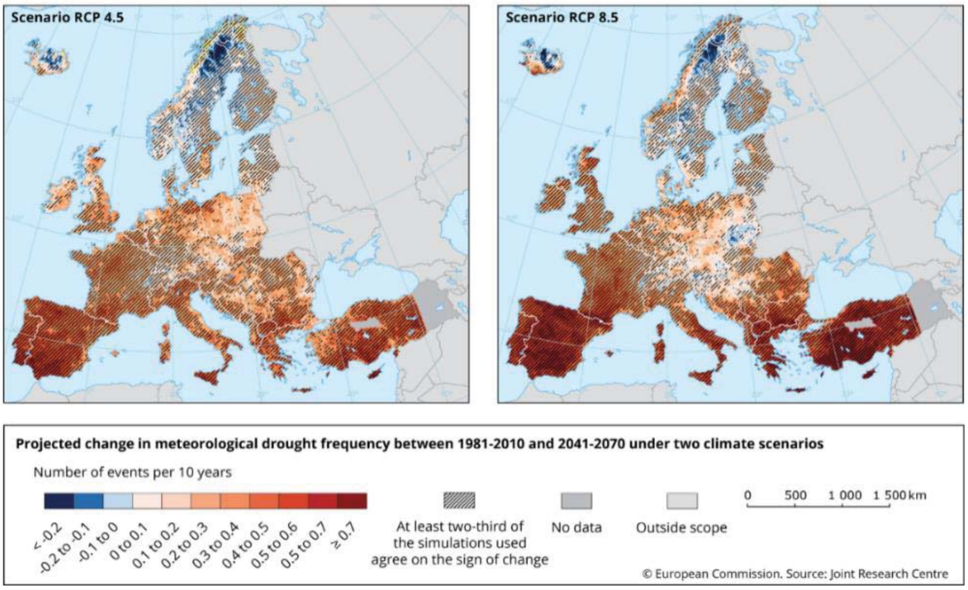
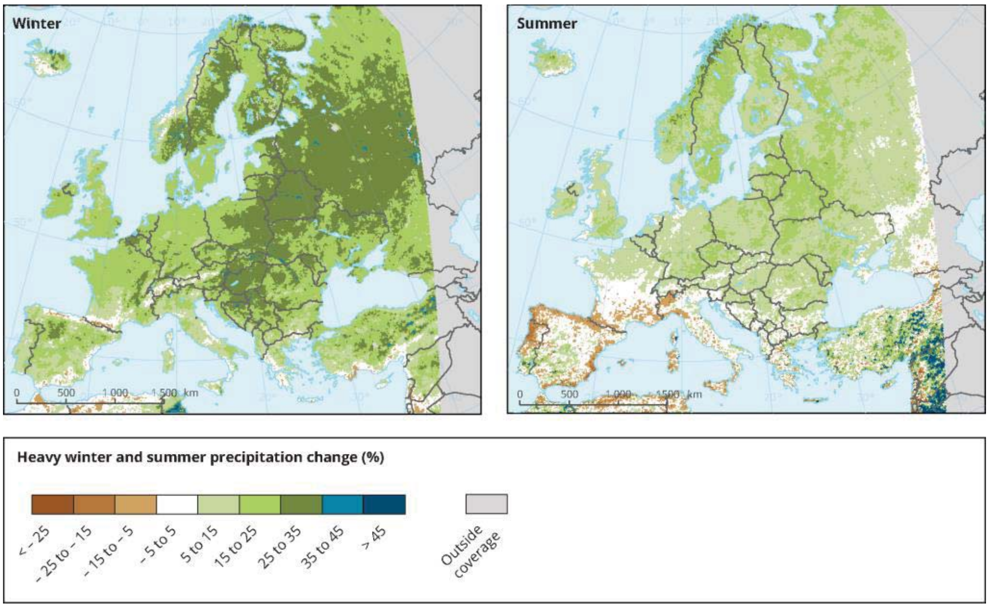


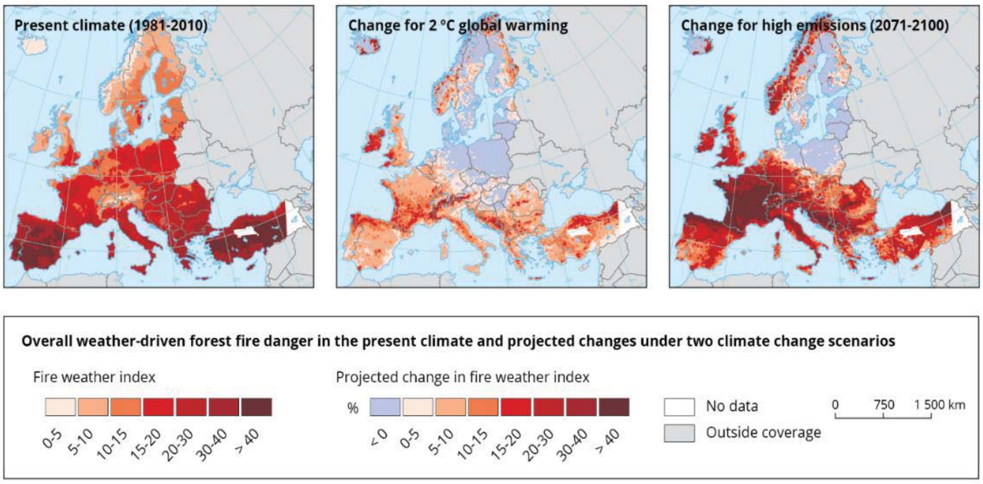
Figure VII-4: Projected changes in heavy precipitation in winter and summer. Projected changes in heavy precipitation (in %) in winter and summer from 1971-2000 to 2071–2100 for the RCP8.5 scenario based on the ensemble mean of different regional climate models (RCMs) nested in different general circulation models (GCMs). Source: EEA, 2019[37]



[36] EEA (2019a) 'Heavy precipitation in Europe. Available at: https://www.eea.europa.eu/data-and-maps/indicators/precipitation-extremes-in-europe-3/assessment-1. Accessed: 29 April 2021.

[37] EEA (2019b) Meteorological and hydrological droughts in Europe. Available at: https://www.eea.europa.eu/data-and-maps/indicators/river-flow-drought-3/assessment

Figure VII-5: Forest fire danger in the present climate and projected changes under two climate change scenarios, one reaching 2°C of warming and another high emissions scenario. Source: EEA, 2019

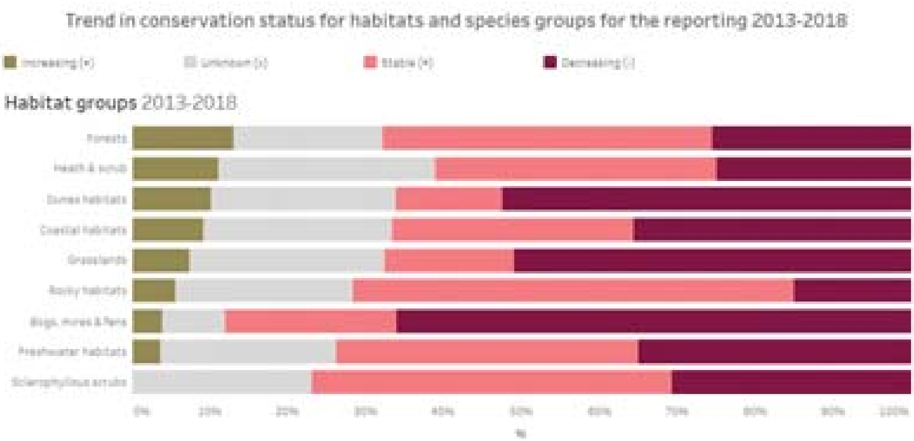


1.3.3. Trends in ecosystem condition

In chapter 2.1 the situation of the state of biodiversity and ecosystems is described but in the context of the baseline it is important to point to the strong and continuing negative trends in the status of protected habitats and species that are reported by Member States every 6 years under the Habitats and Birds Directives and last reported in 2019. Aggregated on EU level it can be said that the that the number of habitats which are reported as deteriorating is much higher than the one of habitats improving in spite of the measures taken under current legislation. This pattern looks very similar for the conservation status trends of protected species under the Habitats Directive: the negative trends outweigh by far the positive ones. **This points to the assumption taken that even with some improvements in the implementation of legislation and new voluntary targets set in the Biodiversity Strategy to 2030 this relationship is unlikely to dramatically change in future.**

Figure VII-6: Trends in conservation status of Habitats Directive Annex I habitats grouped by to ecosystem for the reporting period 2013-2018

Source: State of Nature report, 2020



1.4.Recent legislative developments

1.4.1. International policy

The expectation is that at the CBD COP15 an ambitious new global strategic policy framework will be adopted with different goals and action targets which will require additional nature restoration efforts to be achieved by CBD parties[38]. The EU and all its 27 Member States are Parties to the CBD. However, based on previous experience, in the field of biodiversity policy, international agreements provide the context for EU action rather than being a driver of EU action in itself. International policy strengthens the imperative for EU to act - including to set an example for other countries to follow - but will not drive change by itself and therefore will not have a significant impact on the magnitude of nature restoration in the EU towards 2030 (without additional action). For this reason, international policy is not further discussed here.

1.4.2. European Green Deal

With the European Green Deal (EGD) biodiversity has become a political priority at the highest political level in the EU. The EGD sets out a strategy for a wide range of initiatives which have the potential to contribute to addressing some of the biggest drivers in ecosystems degradation. The most important initiatives, and their likely impact on biodiversity trends and nature restoration, are briefly outlined in this section. The ecosystem-specific sections and annexes to this report contain more in-depth analysis of impacts of these initiatives.

Potentially the most far-reaching initiative for the period up to 2050 is the **European Climate Law** which legally commits all EU MS to achieve climate neutrality by 2050. This has spurred a range of initiatives to integrate this new ambition in existing and new laws and policies[39]. The Impact Assessment accompanying the Communication of the Commission on Stepping up Europe's 2030 climate ambition[40], included modelling of the impacts of reducing Europe's greenhouse gas (GHG) emissions with 50 or 55% relative to 1990 levels by 2030 in line with the new political ambition under the EGD. The "MIX" scenario, leading to a 55% reduction in GHG emissions, adopted a combination of increased ambition for regulatory-based measures and expanded carbon pricing, compared to a baseline scenario. Under this scenario, forest area is expected to expand by 20,000 km^2 per decade, which equates to around 1.5% of forest area based on 2018 Corine land cover. Importantly however, some of this afforestation is for future supply of woody biomass and there is also a limited increase in the proportion of forest under intensive management. Therefore the likely restoration benefits for forest ecosystems will likely be limited without stronger safeguards for biodiversity. In addition, there may be net negative benefits from a biodiversity perspective if high nature value non-forest ecosystems such as (semi-)natural grasslands or wetlands are converted to plantation forest.

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[38] UN CBD (2020) Updated zero draft of the post-2020 Global Biodiversity Framework: https://www.cbd.int/article/zero-draft-update-august-2020

[39] Legislative train schedule for the 'Fit for 55 Package under the European Green Deal': https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/package-fit-for-55

[40] European Commission (2020) SWD(2020) 176 final with the Impact Assessment accompanying the Communication on Stepping up Europe's 2030 climate ambition. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020SC0176

Perhaps the more important feature in the climate targets modelling is the increased production of energy crops for sustainable advanced biofuels and other types of bioenergy after 2030, using land currently occupied by croplands, non-productive grasslands, agriculture land set aside, fallowed or abandoned. This suggests that rather than driving widespread restoration of ecosystems, there is rather the potential for expansion of bioenergy production which if managed unsustainably could undermine restoration objectives of converted ecosystem types: the conversion of large areas of land could lead to loss of extent and deterioration in the ecological condition of agro-ecosystems, wetland, steppe, heath and shrub habitats and possibly other ecosystem types.

Arguably the most relevant element of EU climate policy for nature restoration is the review of the **EU regulation on land use, land use change and forestry (LULUCF)** with the aim of increasing this sector's efforts to reduce emissions and maintain and enhance carbon removals[41]. The impact assessment accompanying the legal proposal to amend the LULUCF regulation[42] refers specifically to the announced proposal for a legally binding instrument for nature restoration under the Biodiversity Strategy to 2030 and makes clear that nature restoration makes a significant contribution to climate action. A wide range of land-based mitigation options including protection and restoration of natural ecosystems, sustainable land management practices (including agroecology), agroforestry, crop rotation with leguminous crops, fire management, soil management, sustainable forest management, reduced erosion and increasing soil organic matter do not increase competition for land. However, afforestation for intensive bioenergy production, including monocultures replacing natural forests and high nature value farmlands, could increase the demand for land conversion, with potentially negative ecological consequences. These trade-offs and synergies between woody biomass for energy production and biodiversity in the EU were the subject of a recent analysis by the JRC[43] which identified as win-win forest management options the removal of slash (fine, woody debris) below thresholds defined according to local conditions, and afforestation of former arable land with mixed forest or naturally regenerating forests. It also cautioned against lose-lose pathways for biodiversity and climate including the removal of coarse woody debris, removal of low stumps, and conversion of primary or natural forests into plantations. As the report rightly concluded, which measures are dis- or encouraged in different EU MS is a political one. Which trajectory MS will take, and how their combined action will add up towards impact on EU-wide nature restoration outcomes is hard to forecast. What is clear that the potential of positive win-wins is very significant, but that without explicit articulation of such win-wins in national/regional policy and land/forest management practice, and in the

[41] European Commission Better Regulation initiative 'Land use, land use change & forestry – review of EU rules': https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12657-Land-use-land-use-change-&-forestry-review-of-EU-rules_en

[42] European Commission (2021) 609 final with the Impact Assessment report accompanying the proposal to amend Regulations (EU) 2018/841 as regards the scope, simplifying the compliance rules, setting out the targets of the Member States for 2030 and committing to the collective achievement of climate neutrality by 2035 in the land use, forestry and agriculture sector, and (EU) 2018/1999 as regards improvement in monitoring, reporting, tracking of progress and review. Available at: https://ec.europa.eu/info/sites/default/files/revision-regulation-ghg-land-use-forestry_with-annex_en.pdf

[43] Camia et al. (2021), "The use of woody biomass for energy production in the EU"

absence clear biodiversity safeguards, the net benefits to biodiversity objectives may in practice be only limited.

Another review which may impact on restoration action towards 2030 is a foreseen revision of the **Renewable Energy Directive (RED)** which intends to minimise the use of crop- and wood-based biofuels, which could reduce pressures on forest and agro-ecosystems by setting higher minimum environmental standards which has the potential to contribute to the recovery of these ecosystems. In summary, although these climate polices will overall help reduce pressures on ecosystems, and may to a certain degree contribute to **passive restoration**, it must be borne in mind that their primary purpose is to reduce carbon emissions, and not explicitly the improvement of ecosystem health nor halting biodiversity loss. Thus, on their own climate policies will contribute to alleviate pressures on ecosystems, but on their own will be greatly insufficient to restore ecosystems to good condition.

Besides the intention to set legally binding targets for nature restoration (which this study supports), the **EU Biodiversity Strategy for 2030**[44] also contains other proposed objectives and initiatives which -if implemented- have the potential to contribute to the recovery of ecosystems. Firstly, the three protected areas targets to increase the share of protected areas to 30 % on land and at sea, to strictly-protect 10 % of protected areas and to effectively manage them is likely to result in important passive restoration action. The increase in protected area would be particularly ground-breaking in the marine environment, in which protected area would more than double (+173 %). Stricter protection could bring important benefits to certain ecosystems, for example in remaining old-growth forests as well as marine ecosystems, which mainly rely on protection measures to recover (passive restoration). Furthermore, the largest positive impact of the three targets in terms of nature restoration across ecosystems would most likely be a concerted effort on management effectiveness, if it is supported with adequate resources to fill existing knowledge and capacity gaps in implementing authorities, as well as with sufficient funding for the implementation of conservation measures. The new **EU Forest Strategy** announced in the EU Biodiversity Strategy and published in July 2021 reiterates its objectives on EU forests, and includes a specific priority of protecting, restoring and enlarging them. These are supported by a range of announced measures, such as protecting old growth and primary forsts and planting 3 billion trees which can contribute to meeting the EU nature restoration. However, as most of these are voluntary, the contribution will likely be relatively limited. The **Regulation on deforestation and forest degradation** proposed by the Commission in November 2021 can be expected to reduce deforestation and forest degradation, but it does not include objectives on ecosystem restoration.

The **Farm to Fork Strategy**[45] was published on the same day as the EU Biodiversity Strategy and shares some of its commitments, e.g. in relation to reducing pesticide- and nutrient pollution. Unlike the EU Biodiversity Strategy, it does not include targets on active protection or restoration of landscape features over 10 % of the land, such as hedgerows and fallow land on farmland. However, it does include a series of targets that could provide important

[44] European Commission web page on the Biodiversity strategy for 2030: https://ec.europa.eu/environment/strategy/biodiversity-strategy-2030_en

[45] European Commission web page on the Farm to Fork Strategy: https://ec.europa.eu/food/farm2fork_en

contributions to improving environmental conditions in conventionally managed farmland e.g., reducing the overall use of and risk of chemical pesticides and the use of more hazardous pesticides by 50 % by 2030, reducing nutrient losses into the environment and increasing the coverage of organic farming to 25 % of the EU's agricultural land by 2030. If the Farm to Fork Strategy's targets will be met, the reduced pollution pressures resulting from meeting these targets will improve basic environmental conditions in agro-ecosystems and have further positive passive restoration benefits on other ecosystem types. Nonetheless the targets do not reverse other key drivers of degradation of agro-ecosystems such as the loss of (semi-) natural grassland and high-biodiversity habitat in and around cropland. In addition the targets set in the Farm to Fork Strategy are currently not binding. Therefore the Strategy's overall positive impact on nature restoration objectives will likely be modest, in particular if targets are not operationalised and met in national/regional agricultural policy and- practice.

Other Green Deal initiatives relevant for nature restoration are the **Zero Pollution Action Plan**[46], which includes a specific commitment to reduce by 25% the EU ecosystems where air pollution threatens biodiversity by 2030. By reducing pollution pressures this is likely to contribute to some degree of passive restoration, but not enough to restore ecosystem condition to the degrees required. The **EU Strategy on Adaptation to Climate Change**[47] which includes a priority of promoting nature-based solutions for adaptation develop their financial case and continue to encourage and support Member States to roll them out in different ways such as guidance and EU funding. However, given that these actions will be voluntary, these contributions are likely to be small.

1.4.3. EU Agricultural, Fisheries and Maritime Policies

Given the large share of ecosystems in Europe that are under agricultural management, the implementation of EU agricultural policy will continue to significantly shape the trajectory of biodiversity trends in the EU in the years to come. It is not possible to predict exactly how the changes in the new CAP compared to the previous CAP may affect the trend in (agro-) ecosystems. They have the potential to do so if they, for example, lead to larger areas of grassland being protected from ploughing, a reduction in inputs such as pesticides, herbicides and excess nutrients, and an increase in the area of semi-natural habitats that are subject tailored and targeted agri-environment climate interventions. A Member State with strong environmental ambitions could use the new measures to achieve a great deal of progress. However, all Member States face competing priorities, and the 2014-20 experience of greening measures is that they have made a limited contribution to improving the environmental performance of farming. The experience so far has revealed limitations in the extent of agriculture funding (EAGF, EAFRD) effectively dedicated to nature restoration. Unless serious

[46] European Commission (2021) COM(2021) 400 final - Pathway to a Healthy Planet for All. EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil'. Available at: https://ec.europa.eu/environment/strategy/zero-pollution-action-plan

[47] European Commission (2021) COM(2021) 82 final - Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change. Available at: https://ec.europa.eu/commission/presscorner/detail/en/ip_21_663

efforts are put into improving the use of these funds, it is expected that they would not be changing the currently observed negative trends in ecosystems condition.

Despite some progress towards sustainable fisheries in the EU found in the evaluation of the EU Biodiversity Strategy to 2020 following the adoption of the new **Common Fisheries Policy** in 2013[48], the evaluation also found that certain fish stocks remain overfished and/or are outside safe biological limits and fisheries impacts on biodiversity remains high, for example on benthic habitats through bottom trawling and on slowly maturing but keystone species such as rays and sharks. As a result, the impact of fisheries and fishing practises on ecosystems remained a key concern in the EU Biodiversity Strategy (BDS) for 2030. The EU Nature Restoration Plan in the Strategy includes a specific commitment to "substantially reduce the negative impacts on sensitive *species and habitats, including on the seabed through fishing … activities, to achieve good environmental status"*. The Strategy aims to achieve this through application of an ecosystem-based management approach under relevant EU legislation (MSFD, CFP, MSP) and mentions specifically the national marine spatial plans under the MSP Directive in which Member States should formalise Marine Protected Areas and other area-based conservation measures. Furthermore, by summer 2022, a new action plan to conserve fisheries resources and protect marine ecosystems will point out where action is needed to address the by-catch of sensitive species and adverse impacts on sensitive habitats through technical measures such as area closures, gear changes and mitigation measures for sensitive species. Importantly, the action plan will also focus on key enabling measures such as strengthening the implementation of existing policies, improving the availability and quality of marine knowledge and information, and identify the possibilities under the EU funding instruments for a fair and just transition to support the objectives of the action plan.

While these ongoing policy developments will focus minds on ecological objectives in the marine environment, and they may contribute to a **certain degree of contribution to passive restoration**, it remains to be seen in how far they will result in larger scale improvement in ecosystem condition and specific, targeted restoration outcomes. Progress in implementing the MSP is significantly behind schedule and so-far poorly aligned with new EU commitments on protected areas and restoration. While the reformed CFP since 2013 provides conservation and management tools to implement measures to support restoration, the implementation of key elements such as the landing obligation and restricting fisheries in areas of ecological importance such as Natura 2000 sites has been slow. Helping achieve the objectives of the MSFD and of the Birds and Habitats Directives forms part of the CFP's objectives, in particular through reaching fully sustainable fisheries, setting fish stock recovery areas and setting conservation measures for complying with the EU's environmental legislation. Hisorically, the CFP has focussed on the socio-economic dimension of fisheries, while the reformed CFP of 2013 has added environmental sustainability as one of its key objectives. Under the regionalisation process, certain Member States proposed conservation measures for protected areas and minimising the risk of by-catch of protected species. Considering the urgency to act, progress is considered slow and additional action would be required under the nature

[48] For example in relation to total allowable catches (TACs), multi-annual plans, landing obligations, technical measures and discard plans.

restoration law to step up the recovery of marine ecosystems. Under the current rules, this is going to continue in future and **despite the hopeful developments since the adoption of the EU Green Deal and the EU Biodiversity Strategy for 2030, the expectation is that ecosystem condition will only slightly improve in the period to 2030 under the baseline scenario.** This would be either through indirect means such as contributions to passive restoration, or through more directed actions, which as experience shows are not likely to have much effect due to their voluntary nature.

1.4.4. Investment

As explained in Chapter 3, insufficient investment in ecological restoration is one of the key barriers to action, even for restoration required under legislation such as under the Nature Directives and the Water Framework Directive. There are some reasons to expect increases both in budgets available for nature restoration as well as their more targeted application, partly enabled by progress in implementation as outlined in section 4.2.2. Firstly, the decision to invest 7,5 % of the EU's Multi-annual Financial Framework (MFF) in biodiversity by 2024, and 10 % by 2027, will increase the overall portfolio available for biodiversity. The European Commission is developing an improved system to track biodiversity-related investments in the EU budget. Another improvement under the current MFF is that the budget for the EU LIFE programme increased by about 60 % compared to the previous MFF cycle, which will result in a significant increase in targeted EU-funded restoration projects.

At the same time, there are concerns that the largest EU investment pillar for biodiversity, could reduce in practice if Member States continue to use the flexibility that CAP implementation provides to prioritize productive measures and investments which often do not or insufficiently deliver on biodiversity objectives or even hamper them. Moreover, Prioritized Action Frameworks for Natura 2000 indicate that funds allocated by EU and Member States have been insufficient to meet needs in the current period. Therefore, it remains to be seen if these slight improvements will be sufficient to bridge the funding gap.

Lastly, the Biodiversity Strategy for 2030 mentions that a dedicated 'EUR 10 billion natural-capital and circular economy investment initiative' will be established, building on InvestEU and operated by the EIB Group in cooperation with other public and private investment teams. Also here it remains to be seen if this will mobilise substantial amounts of private investments for ecosystem restoration, in light of limited success of the Natural Capital Financing Facility.

1.4.5. National developments

An initial and short assessment of national political, policy and legal developments on nature restoration and related fields was carried out as part of this impact assessment. This is described in Annex XI. From this it can be predicted that for some EU Member States, national policies would be likely to have a positive effects on biodiversity trends and nature restoration. However, evidence shows that MS activities are not evenly distributed across the EU and also tend to show degrees of difference in effort and resultant action. Furthermore, in a number of MS, there was little evidence that could be found of restoration activity supported by national policies. All this goes to indicate that one could expect rather small, and unevenly distributed efforts of restoration following from the contributions of national policies.

1.5. Discussion & conclusions

The baseline analysis for specific ecosystems as well as the wider cross-cutting considerations presented above lead to three main findings for the baseline. First, socio-economic and environmental pressures on ecosystem are likely to increase. Second, ongoing restoration activities are limited and, third, they are likely to only slightly increase in future, despite recent policy and legal initiatives. We expand on these findings below.

Socio-economic drivers. In the period to 2050, the EU population is expected to continue to grow, albeit at a reduced rate compared to the recent past. This combined with global population growth and wealth growth will increase demand for natural resources and pressure on productive land use in agriculture, forestry and across other ecosystems. In contrast, agricultural abandonment will continue in remote and less productive agricultural areas, because of socio-economic factors and rural depopulation.

Environmental drivers: the impacts of climate change on ecosystems are increasing. In the future, across most of Europe, drought event frequency, heavy winter precipitation and forest fire risk are all projected to increase, Important cross-cutting pressures such nitrogen pollution will decline further but will be partly offset by accelerating pressures from climate change.

Ongoing restoration. As estimated by Eftec[49] in 2017, areas restored varied by ecosystem but taken together, were insubstantial. When extrapolated to the area restored over the 9-year period covering 2022-2030, they represent less than **1% or less of total ecosystem extent.**At the same time, from the baseline assessments of specific ecosystems outlined in Annex VI, semi-natural grasslands, heathlands and other semi-natural agricultural habitats, and some mires as well as coastal wetlands, would be expected to continue their limited decline. With increasing flood risks we expect that the relative priority given to wetlands and rivers and lake ecosystems in restoration efforts will further increase compared to other ecosystems. Similarly, we expect increased ambition to reduce soil-based GHG emissions and increased investments for land-based climate change mitigation action, including wetland restoration through re-wetting. However, these increases if based on voluntary commitments will likely fall short of needed effort, and more importantly will not deliver on the restoration of other ecosystem types in scope.

Recent policy and legal initiatives. The European Green Deal makes biodiversity a political priority in the EU. The European Climate Law and within that the review of EU regulation on LULUCF and the Renewable Energy Directive, if implemented effectively, have the potential to contribute to ecosystem recovery. The EU Biodiversity Strategy for 2030 will, if implemented, also contribute to improvements in the condition and coverage of European ecosystems. The Farm to Fork Strategy makes commitments to reducing pressures on ecosystems, especially agroecosystems. Higher ambition for biodiversity in agro-ecosystems

[49] Eftec (2017) Technical support in relation to the promotion of ecosystem restoration in the context of the EU Biodiversity Strategy to 2020. Available at: https://ec.europa.eu/environment/nature/pdf/promotion_of_ecosystem_restoration_in_the_context_of_the_EU_biodiversity_strategy_report%20.zip

is also a possibility under the CAP, although it will ultimately depend on the choices made by Member States and it is not possible to assess the impacts of the CAP reform as the reform is still under negotiation. In summary, the is more favourable for nature restoration compared to the recent past. This will likely result in higher restoration action than would be expected based on recent experience and trend.

Considering ongoing and growing pressures on ecosystems and in light of the lack of voluntary implementation of 'Target 2' of the EU Biodiversity Strategy to 2020, we conclude that the baseline restoration effort is likely to remain at an insufficient scale to meet restoration needs. Furthermore, restoration is likely to happen too slowly to reverse the present, steep biodiversity declines and to underpin ecosystem resilience in the face of climate change.

Contributions to restoration are likely to mainly be passive restoration and at insufficient levels to restore ecosystem to good health. Active restoration would only be addressed, and if at all, through voluntary actions, and with little expected impact.

For these reasons, we have considered a 'conservative' baseline in our calculations in which the 'full' restoration needs observed today will not be addressed by the existing policies and legislations outlined above. Therefore, these needs have to be addressed by EU targeted action on restoration.

In summary, the baseline analysis sees several positive developments, but the continuous increase in ecosystem degradation may outweigh their benefits. Without additional action to accelerate progress on nature restoration across different ecosystems, biodiversity and ecosystems would decline further. As the analysis also demonstrated, there is a large potential to improve existing action with a more binding framework.

2. Option 2: Overarching legally Binding target covering all or most EU ecosystems

If there were a single overarching target for ecosystem restoration rather than individual, ecosystem-specific targets, Member States would have greater freedom and flexibility in choosing which ecosystems to prioritise for restoration.

It is important to note that the main flexibility would be in the prioritisation and sequencing of ecosystem restoration since both the overarching target and ecosystem-specific targets would require restoration of all (or almost all) ecosystems by 2050. However, Member States would be free to choose which ecosystems to prioritise at the start of this period and which to leave for later.

Having an overarching rather than ecosystem-specific targets would have advantages in terms of:

- **Subsidiarity**: Member States would have greater flexibility in meeting the targets and could prioritise restoration actions according to their needs and circumstances;

- **Cost-effectiveness**: Member States could prioritise ecosystems with lower costs or higher benefit-cost ratios, which would save costs and/or enhance net benefits in the short to medium term;
- **Contribution to policy objectives**: Member States could prioritise restoration of ecosystems which made greatest contribution to their policy objectives in the short to medium term. This could include, for example, contribution to climate mitigation targets or addressing more local priorities such as reducing flood risk.
- **Political visibility and accessibility:** A single, easy to communicate legally -binding target would facilitate building broad awareness of new EU political and political ambition on nature restoration. Since there is something in it for everyone, it could help ensure buy-in across stakeholder groups and could help put biodiversity on par with 'headline' climate targets such as achieving climate neutrality.

The main disadvantage of an overarching rather than ecosystem-specific targets would be that it might be expected to result in uncertain and uneven rates of restoration of ecosystems. There is a risk that it could result in "picking of low hanging fruit", i.e., prioritisation of restoration of ecosystems that are easiest and most inexpensive to restore. The historic bias in designating protected areas in places which were facing little anthropogenic pressure and therefore had a low opportunity cost is a good example of this phenomenon[50]. Another example are experiences in implementing Greening under the EU's Common Agricultural Policy (CAP) where large flexibility in implementation options led to high inefficiencies from a biodiversity perspective as authorities and farmers prioritized the economically most advantageous options with little to no biodiversity outcomes[51]. While such flexibility could have some advantages in reducing short term costs, there would potentially be adverse impacts on:

- **Biodiversity:** Biodiversity restoration requires coordinated international action as ecosystems and species do not respect national borders**.** This is recognised in the Birds and Habitats Directive and the biogeographical approach in the latter. Therefore, rather than restoring species and habitats according to the EU priorities and biogeographical requirements, prioritising at a Member State level would undermine the ability to achieve coordinated restoration of ecosystems and the recovery of species at a population level. If some species continued to decline, this could reduce progress in meeting overall biodiversity objectives, and some species might face threat of extinction through delays in restoration of their habitats.
- **Future costs**: Prioritising ecosystems with lower costs of restoration could increase the costs of future action.
- **Effectiveness**: Focusing on ecosystems which are easiest and cheapest to restore would potentially increase the risks of failing to deliver against the targets, by leaving the greatest challenges to be addressed in future years.

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[50] See, for example, Joppa, L. & Pfaff A., *High and Far: Biases in the Location of Protected Areas*, 2009.

[51] Alliance Environnement, *Evaluation of the impacts of the CAP on habitats, landscapes, biodiversity,* Report to the European Commission, 2019.

- **Certainty:** There would be greater uncertainty relating to the restoration actions taking place across the EU, and their likely outcomes;
- **Co-ordination**: Variations and uncertainties in action and outcomes at Member State level would make it more difficult to co-ordinate action across the EU, to share evidence and resources, and to implement co-ordinated action across borders.
- **EU Added value:** The absence of co-ordinated action might reduce the ability to achieve EU goals, and therefore the justification for EU funding; and undermine confidence amongst Member States that they can adopt ambitious goals that are comparable to others.

2.1 Factors affecting Prioritisation of Ecosystem Restoration Action

The flexibility inherent in the overarching target option makes it challenging to assess likely implementation scenarios and therefore likely impacts. The prioritisation of ecosystems as described in the baseline scenario would likely still be similar, however the significant increase in effort required in terms of area restored would increase the scope and magnitude of impacts and likely implementation pathways. Therefore, evaluation was made to map the likely decision-making factors that would guide the direction of implementing actions. If there was an overarching target instead of ecosystem-specific targets, we might expect Member States to prioritise restoration of ecosystems according to one or more of the following criteria:

- **Ecosystem extent:** Ecosystems with greater area requiring restoration will make up a greater proportion of an overall restoration target.
- **Technical feasibility**: Member States would be unlikely to prioritise ecosystems which are technically difficult to restore, or where there is a high risk of failure;
- **Cost:** With an overarching target, and given limits on funding, there would be a tendency to prioritise ecosystems with lower restoration costs;
- **Benefit-cost ratio:** There would be merit in prioritising restoration of ecosystems which offer greatest benefits, in terms of the value of ecosystem services, relative to costs of restoration;
- **Opportunity costs/stakeholder resistance**: There may be a tendency to avoid restoring ecosystems in situations where this has high opportunity costs (e.g. because it restricts opportunities for development or food production) and meets resistance from stakeholders (e.g. farmers, fishers and developers);
- **Need for co-ordinated international action:** With a variety of priorities and approaches at Member State level, it might be more difficult to co-ordinate restoration actions across borders, potentially prioritising restoration of ecosystems within national borders;
- **Contribution to climate mitigation and adaptation:** We might expect Member States to prioritise restoration of ecosystems that are particularly sensitive to the direct and indirect effects of climate change as well as ecosystems where this

contributes most to specific policy agendas, including in relation to climate change mitigation and adaptation.

Table VII-1 summarises these issues with respect to the different ecosystem types. The table indicates that these different criteria may have varying effects on the degree to which different ecosystems might be prioritised for restoration, and that there may be different responses by different Member States, according to the emphasis placed on different priorities (e.g. cost, stakeholder interests, climate change agenda) as well as the extent of each ecosystem in each Member State.

2.2 Summary

In conclusion, the introduction of an overarching target would have several important advantages with regards to subsidiarity, cost-effectiveness (at least in the short-term), contribution to policy objectives, political visibility and accessibility. However, by itself it would most likely fail to restore biodiversity at a level required to meet EU-wide and international biodiversity objectives due to an implementation effort that would not be well--balanced to restoration needs of all ecosystems, of insufficient coordination between EU-Member States on EU-wide restoration needs and challenges and required integration with e.g. implementation of the CAP and CFP, low political certainty of restoration outcomes and therefore accountability which may risk undermine EU added value in biodiversity policy.

Table VII-1: Overview table of likely dimensions impacting on the prioritisation of certain ecosystem types over others in implementing an overarching target

Key: Green=Criterion is likely to encourage restoration of this ecosystem within an overall target; Orange=Criterion may have a moderate or mixed effect in encouraging restoration of the ecosystem; Red=Criterion may discourage restoration of this ecosystem within an overall target

Please note: The scope of this impact assessment also includes pollinators and soils which, due their cross-cutting nature, were not included as a separate ecosystem in this table. Their restoration needs would however need be integrated in the implementation of the overarching target under different ecosystem types.

Ecosystem	Ecosystem extent	Technical feasibility	Need for coordinated international action	Cost per hectare	Cost: benefit ratio	Opportunity cost/ stakeholder resistance	Contribution to climate mitigation and adaptation	Contribution to disaster prevention and protection	Overall assessment
Agro-ecosystems	High	Strong evidence base and good experience through agri-environment interventions	Moderate	Moderate for semi-natural habitats, high for improved grasslands and croplands	Good B:C ratios	Would support extensive farming systems. High opportunity costs for intensively farmed areas, which could give rise to resistance without adequate incentives under the CAP	Moderate potential for carbon storage and sequestration; high contribution to adaptation by increasing soil health	Moderate: reducing bare ground, erosion, soil compaction and tillage reduces run-off rates and flooding and landslides	Extensive ecosystem with potential for large scale restoration; depends on incentivising farmers to change land management practices under area-related interventions including agri-environment interventions
Forest	High	Restoration needs and practices are relatively well understood, but	Moderate	Moderate per hectare costs	Good B:C ratios	Moderate – main trade-off is with more	Strong carbon sequestration potential through forest restoration and		Restoration involves significant capital costs, but likely to be

Ecosystem	Ecosystem extent	Technical feasibility	Need for coordinated international action	Cost per hectare	Cost: benefit ratio	Opportunity cost/ stakeholder resistance	Contribution to climate mitigation and adaptation	Contribution to disaster prevention and protection	Overall assessment
		recovery takes many decades				commercial forestry	re-creation [adaptation]		a priority given extensive area of degraded forest, and potential to contribute to climate agenda
Heathland and scrub	w	Restoration needs and practices are relatively well understood	Moderate	Relatively low costs per hectare	Good B:C ratios	Low – relatively low value land with few alternative uses	Strong carbon sequestration potential through restoration,	Moderate: reducing bare ground and overgrazing, reduces run-off, flooding, erosion, and landslides. Risk of intense large fires can be reduced by grazing, scrub management and managed burning	Likely to be prioritised because of relatively low restoration and opportunity costs; however, limited ecosystem area restricts its contribution to overall target
Marine	High	Many habitats may be difficult to restore and/or restoration hampered by evidence gaps.	High – the need for co-ordinated action could be a barrier to restoration without specific	Variable – potential for extensive use of low cost, passive restoration	Uncertain – difficult to assess with given evidence and may vary widely for	Restoration may face significant resistance from fishing sector in response to	Varies by marine habitats; significant uncertainties regarding impact of		Only relevant for MS with a coastline; extent of marine ecosystem

Ecosystem	Ecosystem extent	Technical feasibility	Need for coordinated international action	Cost per hectare	Cost: benefit ratio	Opportunity cost/ stakeholder resistance	Contribution to climate mitigation and adaptation	Contribution to disaster prevention and protection	Overall assessment
		However, other habitats may require passive restoration only.	marine ecosystem targets.	techniques, while active restoration measures may be expensive.	different restoration methods and habitats. May be strong B:C ratios where passive restoration applied.	limits on fishing activity and perceived opportunity costs (at least in short term)	restoration actions		restoration uncertain due to significant knowledge gaps. Could be an attractive option for extensive marine habitats suitable for passive restoration, especially where resistance from fisheries sector does not present challenges.
Peatlands and wetlands	Low	Re-wetting of most drained semi-natural peatland is straightforward, full restoration of highly degraded peatland is difficult	Moderate	Moderate per hectare costs	Good B:C ratios	Low for Annex 1 habitats	Exceptionally high potential for carbon storage and sequestration, improved water retention can also contribute to adaptation	High in flood prone catchments where reversing drainage reduces run-off rates and downstream flooding	Likely to be a priority for restoration for those MS with degraded peatlands, given strong climate

Ecosystem	Ecosystem extent	Technical feasibility	Need for coordinated international action	Cost per hectare	Cost: benefit ratio	Opportunity cost/ stakeholder resistance	Contribution to climate mitigation and adaptation	Contribution to disaster prevention and protection	Overall assessment
									mitigation benefits.
Rivers and Lakes	Low	Technical challenges in barrier removal and floodplain restoration	High – the need for co-ordinated action could be a barrier to restoration without specific freshwater ecosystem targets.	High – often requiring substantial capital works	High B:C ratios, given high ecosystem service values for freshwaters	Opportunity costs are a barrier to floodplain restoration	Relatively low priority for mitigation, but floodplain restoration plays important role in adaptation	High – Restoring wetlands and floodplains can contribute to flood prevention and mitigation through improved connectivity	Restoration has relatively high costs but offers strong benefit cost ratios; as freshwaters represent a small proportion of overall area, likely to be driven more by MS priorities than an overall target
Urban	w	Significant technical challenges in unsealing land, recycling developed and contaminated sites	Moderate	High – costs of unsealing land, remediating contaminated sites, changing construction practices	High B:C ratios for urban green space, especially through health and wellbeing benefits	High land prices and many competing demands for land in urban areas	Importance of urban green space, tree cover, sustainable drainage in climate change adaptation		Limited land area and high costs, but also high benefits. Urban ecosystem restoration more likely to be driven by MS priorities than its

Ecosystem	Ecosystem extent	Technical feasibility	Need for coordinated international action	Cost per hectare	Cost: benefit ratio	Opportunity cost/ stakeholder resistance	Contribution to climate mitigation and adaptation	Contribution to disaster prevention and protection	Overall assessment
									contribution to an overarching target.

3. OPTION 3 AND OPTION 4

See individual thematic assessments in Annex VI, summary table in Annex III, as well as Chapter 6.

4. COSTS OF ENABLING MEASURES

Enabling measures will include:

a) Surveys of ecosystems to establish extent and condition, where this is not known;
b) Development of national restoration plans;
c) Administration of restoration measures;
d) Monitoring of restored ecosystems;
e) Reporting progress against restoration targets.

The administrative costs of these measures can be estimated by estimating the number of days work involved for each, and costing that at a standard time cost per day (following the Standard Cost Model for quantification of administrative burdens, set out in the EU Better Regulation Guidelines and Toolbox).

a) Ecosystem surveys

Establishing the extent of restoration activity required depends on data on the extent and condition of the relevant ecosystems. There are currently significant data gaps, particularly regarding the extent of degraded ecosystems requiring restoration. The **EEA Dashboard**[52] indicates that the condition of approximately 732 516 km^2 of Annex 1 habitats across the EU is unknown, and would need to be surveyed to determine restoration priorities. We assume a survey cost of EUR 15/ha surveyed, based on data for from the EMBAL survey[53]. This would give a total one-off survey cost of EUR 1 099 million across the EU.

b) Development of national restoration plans

Each Member State will be required to develop a national restoration plan. This will set out the current extent and condition of ecosystems, the pressures facing them, the targets for ecosystem restoration, the restoration measures required, the stakeholders involved, the resource needs and funding arrangements, and the arrangements for monitoring and reporting.

[52] https://www.eea.europa.eu/themes/biodiversity/state-of-nature-in-the-eu/article-17-national-summary-dashboards/condition-of-habitat.

[53] Costings for EMBAL assume 3 x 25 hectare plots are covered per day, with an average daily cost of EUR 557 for skilled surveyors. If it is assumed that 50 % of surveyor time is spent in the field, this gives an average cost of EUR 15 per hectare.

Each Plan could be subdivided into approx. 6 ecosystem types (e.g. marine and inter-tidal habitats; wetlands & peatlands; rivers & lakes; agro-ecosystems (including soils and pollinators); heaths etc; forests), presenting a specific plan for each ecosystem.

The time and costs required for each Plan would vary by Member State, according to the extent of their ecosystems and the complexity of issues and restoration requirements. The average time requirements for each Member State Plan are estimated in Table VII-2.

Table VII-2 Estimated time inputs for national restoration plans

Requirement/ section	Time input per ecosystem (days)	Total days per plan (based on 6 ecosystems)
Compile and present data on ecosystem extent, condition, pressures	100	600
Define ecosystem restoration targets and actions	50	300
Define resources and funding arrangements	30	180
Define monitoring and reporting arrangements	30	180
Public consultation/ engagement	40	240
Compile overall national plan		100
Total time	**250**	**1,500**

It is estimated that each National Restoration Plan (covering the 6 ecosystem types) would require total time inputs amounting to 1500 days on average, or 6.5 person years of work.

In this assessment we apply a standard cost of EUR 317 per day – this includes salary and overhead costs and is based on the civil rate of EUR 300 per day for public servants applied in the Fitness Check of EU Environmental Monitoring and Reporting Obligations (ICF, 2017), updated for inflation.

Applying an average cost of EUR 317 per day would give an average cost of EUR 475 500 per MS plan. **The total for 27 Member State plans would amount to a one-off cost of EUR 12.8 million.**

c) **Establishing an EU wide methodology, indicators and baselines for ecosystems and targets**

Further administrative effort is required to establish an EU wide methodology, indicators and baselines for targets for those ecosystems for which these are insufficiently developed. This includes targets for at least five ecosystems (e.g. marine, urban, soils, agro-ecosystems, forests or others for which targets are yet not defined, as well as pollinators). The cost estimate for establishing an EU wide methodology, indicators and baselines for ecosystems is based on two methods:

Method 1: based on experience with MSFD

Based on experience of developing methodologies, baselines and indicators under the MSFD, it is estimated that this will require work over a period of 3-4 years with inputs from the European Commission, EU experts (EEA, JRC) and Member State officials.

Over the 3-4 year time period, this is estimated to involve:

- 1 EC staff member working full time to oversee the development of the EU wide methodology and indicators for each ecosystem [800 days per ecosystem]
- 8 EU experts (EEA, JRC, DG ENV) spending an average of 25 days each on data analysis and indicator development [700 days per ecosystem]
- 27 Member State experts spending 20 days per year each on meetings/ networks/ data inputs [1890 days per ecosystem].

On this basis, total time inputs would amount to 3 390 days at a cost of EUR 1.07 million per indicator (based on a cost per day of EUR 317 as above). This would amount to a total one-off cost of EUR 5.35 million across the five ecosystems.

Method 2: based on experience with MAES – Mapping and Assessing Ecosystem Services

Since the mapping of ecosystems and assessment of ecosystem services started in 2016 under MAES, the progress that was made by Member States until March 2021 is outlined by the light green in the figure below:

Figure VII-7: Progress by MS to map ecosystems and its services under MAES

Source: MAES

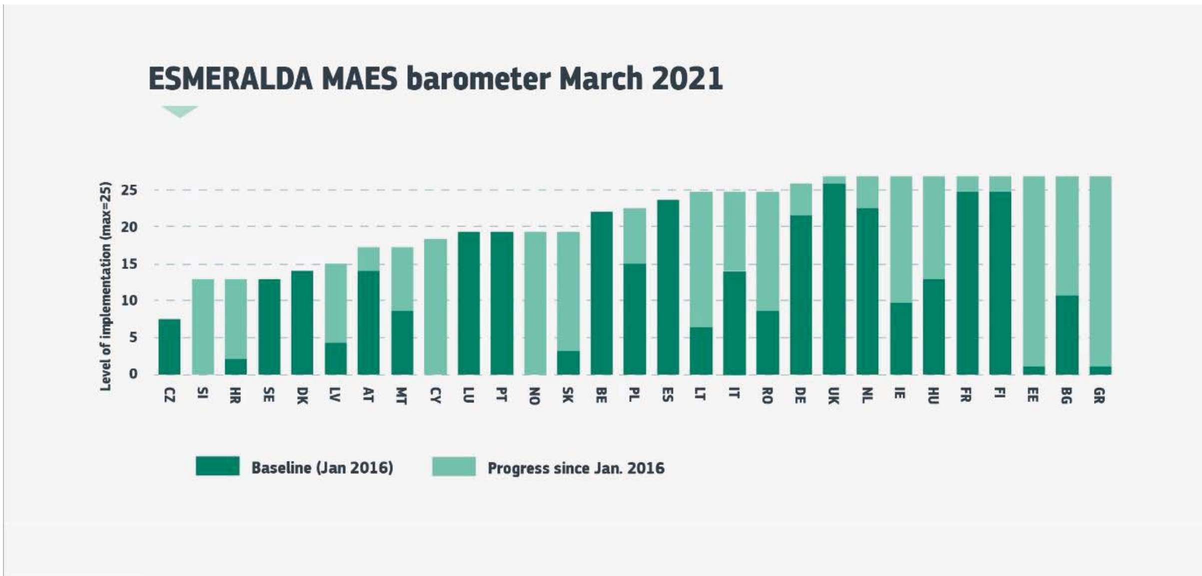

Figure 14. Measuring successful implementation of MAES in the 27 EU member states, Norway and the UK. The barometer measures implementation of MAES based on a set of 25 yes/no questions that survey the progress made in policy integration and research. A baseline was set in January 2016 and since then the progress has been measured every six months until March 2021.

At EU level, for JRC and EEA a total of 2 FTE per year has been occupied to write the guidance reports and to carry out the EU ecosystem assessment under MAES between 2013 and 2020.

MAES was mainly implemented by countries (but in some cases supported with EU or European Economic Area budgets). Every MS that made progress between 2016 and 2021 (in the Figure VII-7) has used a budget between EUR 100,000 and 1.5 million. This range does not consider costs incurred by a number of MS (Finland, Netherlands, UK, Spain, Portugal, Luxembourg, Denmark, Sweden and Czechia) that did work relevant to MAES prior to 2016 or even 2013. For MS that primarily used national budgets, project costs are estimated to range between EUR 100 000 (Ireland, Italy, Poland, Slovakia, Cyprus, Slovenia and Malta), EUR 300 000 (Estonia, Latvia and Lithuania) and EUR 1 000 000-2 000 000 (Hungary, Greece, Bulgaria, Romania and Croatia).

Additional costs were covered by projects like H2020 ESMERALDA (3 000 000) and MESEU and Train (ENV service contracts, 400 000) to help MS implement MAES.

Thus, the costs for implementing MAES (2013-2020) are estimated at EUR 16.5 million, which is comparable to the size of an average Horizon research project.

Cost item	Amount in EUR
EU staff	1.5 million
MS own financing	5 million
EU support to member states (through EU budgets under LIFE, Regional, service contracts H2020, EEA grants Norway):	10 million
Total	***16.5 million***

Translating these estimations for MAES to the context of establishing an EU wide methodology, indicators and baselines for ecosystems, a one-off cost of around **EUR 7.8 million** can be expected.

Cost item	Amount in EUR
EU staff: 2 FTE for 4 years at EU level	800 000
MS own financing	4 million (150 000 per MS)
EU projects to give overall support and guidance	3 million
Total	***7.8 million***

Conclusion

The average of both cost estimates (EUR 5.35 million for MSFD and EUR 7.8 million for MAES) leads to the one-off cost estimate of **EUR 6.56 million** to establish an EU wide methodology, indicators and baselines for the 5 afore mentioned ecosystems.

d) Administration of restoration measures

The impact assessment estimates the costs of the measures required to meet ecosystem restoration targets. In addition to the costs of the restoration works, further costs will be incurred by Member State authorities in administering programmes of restoration action.

Based on data from the Prioritised Action Frameworks (PAFs), we estimate that the costs of administration and communications (excluding surveys, planning, and monitoring, which are estimated here separately) account for an average of 10 % of the costs of nature conservation measures.

Table VII-3 presents estimates of the annual costs of habitat restoration, maintenance, and re-creation measures for five types of HD Annex 1 habitats, based on analysis for this impact assessment study. The annual cost of these measures is estimated at EUR 4.4 billion over the 9 years 2022-2030, based on the 15 % ecosystem restoration target. Based on estimated administration costs at 10 % of the costs of these measures, the costs of administering these habitat actions will amount to a further EUR 438 million across the EU each year.

Table VII-3 Estimated costs of administration of restoration measures for Annex 1 habitats (EURO)

Ecosystem	Estimated Annual Average Costs, 15 % restoration target (2022-2030)	Estimated Annual Administration Costs at 10 %
Forests	2 607 607 200	260 760 720
Grasslands	1 220 709 426	122 070 943
Heathlands and scrublands	168 896 807	16 889 681
Marshes	164 950 693	16 495 069
Peatlands	221 050 458	22 105 046
Total	**4 383 214 584**	**438 321 458**

e) Monitoring of restored ecosystems

Ecosystem restoration needs to be followed by a programme of monitoring, to record changes in condition of ecosystems in response to restoration measures.

We estimate that monitoring will be required for restored and re-created ecosystems <u>on average</u> as follows:

- One visit to all areas 1 year after restoration
- 60 % of restored areas 2 years after restoration
- 30 % of restored areas 3 years after restoration
- On average, visits to all areas once every 6 years, to coincide with BHD, WFD and MSFD reporting, adjusted to risk (e.g. more frequent visits to areas that have the potential to change rapidly)

This implies that each restored hectare would be monitored on average 4.3 times over the period 2022-2050 (based on a 90 % restoration target by 2050). However, based on current practice Member States would only sample 10-15% of area which would provide a sufficiently representative sample.

The EEA Dashboard indicates that a total of between 321 220 km^2 and 1 053 736km^2 of Annex 1 habitats require restoration across the EU, based on the areas known not to be in good condition and those in not good or unknown condition, respectively.

Applying an average monitoring cost of EUR 15/ha (see under survey costs above) on 15 % of restored area, and a 90 % restoration target by 2050, would give a total monitoring cost of between EUR 280 million and EUR 918 million over the period 2022-2050, or an average of EUR 10 to 32 million per year (midpoint EUR 21 million per year).

f) Regulatory reporting

Member States will be required to report to the Commission progress in implementing restoration plans and in restoring the condition of degraded ecosystems.

It is assumed that reporting will be based on existing data collected under the actions identified above, and require inputs averaging 50 -100 days per Member State every 6 years (similar to requirements under the Habitats Directive; ICF, 2017).

On this basis, and applying a cost of EUR 317 per person day of work required, costs of regulatory reporting would amount to approximately EUR 107 000 per year across the EU27.

Table VII-4 Summary of Costs of Enabling Measures

	Estimated Costs	
	One-off costs	**Annual costs**
Surveys of ecosystems	1 099 000 000	
Development of national restoration plans;	12 800 000	
Development of methodologies and indicators (5 ecosystems)	6 580 000	
Administration of restoration measures (2022-2030; 15 % target)		438 321 000
Monitoring of restored ecosystems		20 643 103
Reporting progress against restoration targets		107 000
Sub-total	***1 118 380 000***	***459 071 103***
Costs from 2022 to 2050	***1 118 380 000***	***12 853 990 884***
Total costs from 2022 to 2050		***13 972 370 884***

Annex VIII: Background information for potential restoration targets

This Annex includes facts and figures per ecosystem derived from the Member States' reporting and assessments under Article 17 of the Habitats Directive (source: EEA).

Because of its size, it is split and provided in separate files.

Annex IX: Key relevant findings from the evaluation study on the EU Biodiversity Strategy to 2020

1. THE EU BIODIVERSITY STRATEGY TO 2020

The EU Biodiversity Strategy to 2020[54] provided the EU framework for action on biodiversity in the 2011-2020 period. It responded to the EU's global commitments under the Convention on Biological Diversity. It set out the following targets, actions and horizontal measures:

Headline target: Halt the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restore them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss.
Target 1: Fully implement EU Nature Legislation To halt the deterioration in the status of all species and habitats covered by EU nature legislation and *achieve a significant and measurable improvement in their status so that, by 2020, compared to current assessments, 100 % more habitat assessments and 50 % more species assessments under the Habitats Directive show an improved conservation status; and 50 % more species assessments under the Birds Directive show a secure or improved status.*
Target 2: Maintain and restore ecosystems and their services *By 2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15 % of degraded ecosystems*
Target 3: Increase the contribution of agriculture and forestry to biodiversity *By 2020, maximise areas under agriculture across grasslands, arable land and permanent crops that are covered by biodiversity-related measures under the CAP so as to ensure the conservation of biodiversity and to bring about a measurable improvement in the conservation status of species and habitats that depend on or are affected by agriculture and in the provision of ecosystem services.* *By 2020, Forest Management Plans or equivalent instruments, in line with Sustainable Forest Management (SFM), are in place for all forests that are publicly owned and for forest holdings above a certain size that receive funding under the EU Rural Development Policy so as to bring about a measurable improvement in the conservation status of species and habitats that depend on or are affected by forestry and in the provision of related ecosystem services.*
Target 4: Ensure sustainable fisheries and support healthy marine ecosystems *Achieve Maximum Sustainable Yield (MSY) by 2015. Achieve a population age and size distribution indicative of a healthy stock, through fisheries management with no significant adverse impacts on other stocks, species and ecosystems, in support of achieving Good Environmental Status by 2020, as required under the Marine Strategy Framework Directive.*
Target 5: Combat Invasive Alien Species
Target 6: Help avert global biodiversity loss
Horizontal measures: Strengthen financing, partnerships and governance

[54] Our life insurance, our natural capital: an EU biodiversity strategy to 2020 (COM/2011/244 final).

2. EVALUATION OF THE EU BIODIVERSITY STRATEGY TO 2020

In March 2022, the Commission published the report of a support study on the evaluation of the Strategy implementation[55] assessing its effectiveness, efficiency, relevance, coherence and EU added value. It concluded that progress towards the headline target has been limited, and the target has not been reached. None of the six targets of the Strategy have been fully achieved, despite numerous actions being undertaken. Biodiversity, and the flow of benefits from healthy ecosystems, has continued to decline in the EU[56] and globally[57]. Although many of the Strategy's actions have been delivered, progress on the ground has been too slow and uneven, and its effect limited by continued pressures on biodiversity from human activities[58]. The findings of the evaluation study indicate that, in terms of implementation progress[59]:

- **Progress to the headline target has been limited.** There have been positive examples of pressures reduction, restoration and sustainable management of ecosystems, that demonstrate the feasibility of halting and reversing biodiversity loss. However, their scale has been too small to reverse degradation, and the loss of biodiversity and ecosystem services has continued in the EU and globally.
- **Progress to Target 1 has been moderate** (despite significant progress in implementing the actions). Less than half (47 %) of all species assessments under the Birds Directive, and only 15 % of habitat assessments under the Habitats Directive showed good status in the 2013-2018 reporting period (a decrease compared to the 2010 biodiversity baseline). The proportion of species assessments under the Habitats Directive that show favourable status or improving trends has increased from 17 % to 27 %. Despite progress in designation, the achievement of favourable conservation status has been hindered by management deficiencies such as a lack of adequate conservation objectives and measures for many sites, conflicting land management objectives, and funding constraints (funding has increased but remains clearly insufficient).
- **Progress to Target 2 has been limited** (despite significant progress in implementing the actions). The initiative on the Mapping and Assessment of Ecosystems and their Services (MAES) has helped to build a significant knowledge base on EU ecosystems and the services they provide, and the EU Green Infrastructure Strategy (2013) has helped to mobilise funding for green infrastructure from EU instruments. The Commission has provided guidance to the Member States on developing Restoration

[55] Trinomics B.V. (2021) Support to the evaluation of the EU Biodiversity Strategy to 2020, and follow-up: Final study report (Publications Office of the EU, 2022).

[56] European Environment Agency, State of Nature in the EU 2020, European environment — state and outlook 2020 (SOER), 2020.

[57] Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).

[58] In particular related to land take and use intensification, the over-extraction of biological resources (such as timber and fish), pollution (such as pesticides and nutrients), and the increasing impacts of climate change and invasive alien species. See EU Ecosystem assessment (JRC 2020).

[59] See SWD/2021/XXX, Section 3.1. Implementation progress.

Prioritisation Frameworks to advance towards the 15 % restoration target. However, only a few Member States have presented such frameworks and restoration progress has been slow and uneven. Pressures on ecosystems continue and affect their capacity to deliver essential benefits to people.

- **Progress to Target 3 has been limited** (despite moderate progress in implementing the actions). Biodiversity has continued to decline in agricultural habitats, and to a lesser extent in forests. In agroecosystems, these declines have been primarily because of two trends: (i) intensification of cultivation techniques on most grasslands and croplands, involving high fertiliser and pesticide use, crop specialisation, increases in field size and losses of non-farmed habitats and landscape features, on the one hand, and (ii) agricultural abandonment (and in some cases, conversion) in semi natural habitats, such as semi-natural grasslands. In forest ecosystems, investments in improving forest resilience, including biodiversity aspects, were included in more than two-thirds of the national Rural Development programmes, however payments for biodiversity had a limited uptake. Budgets and uptake have been far below the scale of implementation required for Member States to meet their legal obligations under the Habitats and Birds Directives.
- **Progress to Target 4 has been limited** (despite moderate progress in implementing the actions). Thanks to measures under the revised Common Fisheries Policy, several commercial fish stocks have shown recovery. However, other stocks have continued to be overfished and/or are outside the safe biological limit. Data gaps (on the status and trends of marine ecosystems) hinder the design of effective marine biodiversity measures. Further pressures from land and sea use, pollution, invasive alien species and climate change need to be addressed to achieve Good Environmental Status of marine ecosystems.
- **Progress to Target 5 has been limited** (despite full implementation of the actions). The adoption of the IAS Regulation and the strengthening of the EU plant and animal health regimes have been important first steps to combat IAS in the EU. Implementation on the ground is still in its early stages and its full impact is yet to be realized. Invasive alien species remain a persistent and growing threat across the EU ecosystems.
- **Progress to Target 6 has been limited,** despite measures to increase financing and support for global biodiversity, tackle illegal wildlife trade and some drivers of global biodiversity loss related to EU consumption (such as deforestation). Biodiversity and ecosystem functions and services are deteriorating worldwide.
- **Horizontal measures** (governance, partnerships and financing) have been moderately successful: there are many examples of partnership-building activities across the targets, with actions focused on information-sharing and collaboration. Significant action has been undertaken to integrate biodiversity objectives in the EU policies in the 2014-2020 budget and to increase the contribution of related funding instruments to EU and global biodiversity. However, funding has continued to be a major limitation to implementation across all targets. The lack of legally binding provisions, and the

absence of a dedicated financing instrument have been identified as challenges for funding mobilisation.

The Strategy and its targets were widely recognised by experts and stakeholders as being **relevant** to the EU's needs with respect to biodiversity, as evidenced by the literature review, stakeholder interviews and national case studies. However, stakeholders consulted in the course of the evaluation support study have pointed to issues that should have been given greater prominence such as **climate change**; **cultural heritage and landscapes**; more emphasis on **the range of ecosystems** and the **range of pressures on biodiversity** in each main ecosystem type in the EU.

The evaluation lessons emerging in the course of the evaluation support study have been considered in the development of the EU Biodiversity Strategy for 2030, and they will inform the design of measures to deliver the 2030 commitments. Findings and lessons of pertinence to the impact assessment of binding EU nature restoration targets are presented below.

3. KEY FINDINGS OF RELEVANCE TO THE EU NATURE RESTORATION TARGETS

3.1. Achievements in implementation

The implementation of the Strategy has been associated with a range of positive achievements and impacts[60]:

- **Examples of successful local protection and restoration**, including the restoration of degraded vulnerable habitats and the return of emblematic bird and mammal species, as well as deployment of nature-based solutions and green infrastructure. While projects financed to date often do not have the critical mass to reverse the trends of biodiversity loss, ***they have demonstrated the feasibility of biodiversity protection and restoration, as well as the benefits arising from healthy nature***. Evidence overwhelmingly indicates that the benefits flowing from healthy ecosystems far exceed the costs related to their protection, restoration and sustainable management, across all biodiversity targets[61].
- **The EU Green Infrastructure Strategy**[62] has encouraged the inclusion of green infrastructure measures in various national biodiversity strategies and plans and policy documents, such as on the sustainable development of coastal areas, climate change adaptation strategies, and EU urban policy[63]. Increased political momentum and actions by cities to create green infrastructure have also been noted in some Member States.
- The implementation of the Strategy has resulted in **significant improvements of the knowledge base on ecosystems and their services**, via the initiative on the Mapping and assessment of ecosystems and their services, with the involvement of national

[60] See SWD/2021/XXX, Section 5.1 Effectiveness, 5.1.2. Major achievements and challenges, and underlying factors.

[61] See SWD/2021/XXX, Section 5.2 Efficiency, 5.2.1. Cost-effectiveness and socio-economic impacts.

[62] EU Green Infrastructure Strategy (COM/2013/249 final).

[63] Review of progress on the implementation of the EU green infrastructure strategy (COM/2019/236 final).

authorities and the science and research community in all Member States. The methodological framework was applied in the first EU-wide assessment of ecosystems and their services published by the Commission at the end of 2020. Member States have also developed initiatives to engage stakeholders and citizens in knowledge and monitoring work, thus supporting both data collection and awareness raising.

3.2. Failures in implementation

Despite these successes, the evaluation also identified significant shortcomings. These include, in relation to restoration efforts:

- While there are examples of local restoration success, ***data on ecosystem restoration efforts in the EU is incomplete***. The non-binding nature of the Strategy means that there are no reporting mechanisms linked to it (beyond those established under existing legislation)[64].
- Estimates in studies suggest that ***restoration activity is significantly below what would have been required*** to reach the target of restoring 15 % of degraded ecosystems: between 2 850km^2 and 5 700 km^2 of habitat restoration is occurring annually in the EU, whereas the restoration needs of Annex I habitats alone (i.e. assessments reported in 'not good' condition) are estimated at between 167 000 km^2 to 263 000 km.
- The Commission provided guidance (in 2014) and requested the Member States to develop ***Restoration Prioritisation Strategies*** in order to improve the quality, scale and consistency of ecosystem restoration, whilst also defining areas of intervention which can be used to target EU funds. However, very few Member States developed and submitted such strategies. ***The absence of Restoration Prioritisation Frameworks (RPF) has been a barrier to the strategic planning, financing, implementation and monitoring of restoration activities.***
- ***Challenges to the achievement of the Nature Directives***[65] related to the availability and targeting of funding and other resources, weaknesses in the management of Natura 2000 sites, and incoherence with other policies and activities.
- ***Approaches to implementation and the uptake of biodiversity support measures in EU instruments*** have been uneven across the Member States in the implementation of EU policies and related funding instruments.
- ***Many direct and indirect pressures and drivers of biodiversity loss have persisted or increased***, with a significant proportion of these accelerating in recent times.

3.3. Factors of success or failure

The evaluation identified a range of factors that have enabled or hindered progress, including:

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[64] See SWD/2021/XXX, Section 5.1 Effectiveness, 5.1.2. Major achievements and challenges, and underlying factors.

[65] Fitness Check of the EU Nature Directives.

- ***Policy integration.*** Mainstreaming and prioritizing biodiversity objectives in other EU policies is essential, considering the complex interactions between biodiversity, the provision of ecosystem services, the impacts of land, water and sea use and management and the potential of nature-based solutions to contribute to wider environmental and socio-economic objectives. While policy integration increased under the Strategy, it has remained insufficient. ***Biodiversity targets of voluntary nature were not systematically prioritised for funding in the design and implementation of EU instruments in other policy areas, and measures of low or no positive biodiversity impact were often favoured in national programming.***
- ***Understanding of win-win approaches*** between biodiversity protection and restoration, on the one hand, and wider environmental and socio-economic objectives on the other. Such understanding could increase the deployment of nature-based solutions for biodiversity and climate adaptation, carbon sequestration and storage, disaster prevention and other benefits from healthy ecosystems. Biodiversity loss and climate change are closely linked, yet the potential for synergies between improving ecosystem resilience and nature based solutions, on the one hand, and climate mitigation and adaptation, on the other, has not been sufficiently used. In addition, awareness and understanding of natural capital and nature-related financial risk is needed to encourage greater private sector engagement in efforts to protect and restore biodiversity and ensure its sustainable management.
- ***Resources for implementation.*** Funding for biodiversity has increased since 2010 but remains clearly insufficient. ***Insufficient funding was commonly cited as a key barrier to restoration.*** The Strategy did not specify the biodiversity financing needs and set no target, which was a major setback in securing the needed resources.

Box 1. Cost-effectiveness of biodiversity protection and restoration

Despite significant variations of magnitude in estimates, evidence overwhelmingly indicates that the benefits flowing from healthy ecosystems far exceed the costs related to their protection, restoration and sustainable management, across all biodiversity targets.

The actual costs of Target 2 implementation activities in 2016 were estimated at between €4.8 million and €33.1 million (highly uncertain). The one-off cost of restoring 15 % of degraded ecosystems has been estimated at around €9.6 billion, and the additional cost of maintaining all restored ecosystems in good condition was estimated at €618 to €1 660 million per year. Restoration activity has been significantly below what would be required to fulfil Target 2, and the realised total expenditure during the 2010-2020 period is significantly lower.

The total benefits of implementation across the EU cannot be estimated or monetised due to lack of systematically collated evidence on the restoration undertaken. Economic activity associated with ecosystem restoration has been estimated to be between €11.5 and €79.5 million. Restoration and the deployment of green infrastructure contribute to a range of socio-economic benefits linked to improved air and water quality, flood control, noise reduction, recreation and social opportunities, pollination, soil fertility and health. The restoration of forest, wetlands and other ecosystems has brought millions of euros in savings across the EU due to lower water retention and purification costs[66, 67]. National parks can generate substantial employment both directly and indirectly in the broader region[68]. Urban green infrastructure can generate benefits in the form of enhanced health and well-being[69]. According to some estimates, 110 000 direct FTE jobs each year can be supported by investment needed to achieve Target 2 (15 % restoration)[70]. However, very little of the required investment and restoration effort has materialised, and thus most of these benefits and jobs were not created.

EU and international studies have shown that investments in marine biodiversity can generate high economic returns in enhanced yields, higher quality fish products, and tourism. Funding allocated to measures for the protection and restoration of marine biodiversity under the European Maritime and Fisheries Fund has been estimated at around €199 million in 2015, €134 million in 2016, €136 million in 2017, €90 million in 2018 and €128 million in 2019. The benefits provided by healthy fish stocks and oceans are immeasurable.

The Strategy has not fully achieved any of its Targets. This means that not only the full benefits provided by the Strategy's targets and actions have not materialised, but also natural capital and ecosystem services are further deteriorating. Other socio-economic impacts, such as health impacts, social vulnerability, and safety, can also emerge due to the failure to protect biodiversity and ecosystems. Human induced biodiversity loss also undermines efforts to mitigate climate change and adapt to its inevitable impacts.

- ***The choice of policy instrument.*** The voluntary nature of the Strategy has been commonly cited by environmental organisations as a key reason for limited action and progress on the biodiversity agenda throughout Europe, particularly in relation to the low response in developing Restoration Prioritisation Frameworks, and restoration efforts lagging far behind the 15 % ambition set in Target 2.

Box 2: The nature of the Strategy as an instrument

The EU Biodiversity Strategy to 2020 had an important role in providing a coherent, strategic EU level framework, giving rise to political commitment, setting common targets, actions and mechanisms for their coordinated implementation and progress tracking, and providing links with other relevant EU policies and legislation. At the same time, the Strategy constituted a largely voluntary framework within which a range of instruments, from voluntary to binding ones, needed to work together to

[66] EEA Report No 6/2016 European forest ecosystems. State and trends.

[67] Siuta and Nedelciu, *Report on Socio-Economic Benefits of Wetland Restoration in Central and Eastern Europe*, a publication by CEEweb for Biodiversity, 2016, Budapest, Hungary.

[68] Nunes et al., *The Social Dimension of Biodiversity Policy: Final Report*, 2011.

[69] European Environment Agency Report No 21/2019 *Healthy environment, healthy lives: how the environment influences health and well-being in Europe*.

[70] ICF et al., *The EU biodiversity objectives and the labour market: benefits and identification of skill gaps in the current workforce*, 2012.

ensure delivery. The evaluation examined whether alternative policy tools would have had the potential to better deliver the targets in a cost-effective manner than a strategy. Implementation experience has helped to identify areas within this wider strategic framework, within which:

- **voluntary mechanisms and incentives worked well based on the motivation of stakeholders to engage** in biodiversity efforts, such as cooperation of front-running businesses in the EU Business@Biodiversity Platform, or the development of green infrastructure in EU regions and cities that had already set for themselves ambitious biodiversity objectives.

- **voluntary instruments worked well in support of the implementation and enforcement of EU legislation** in the Member States, such as the provision of Commission guidance on Natura 2000 for different sectors, or the biogeographical cooperation process helping to implement the EU Nature Directives.

- **reliance on voluntary instruments alone was not sufficient to ensure delivery,** in particular when urgent, strategic and large scale action was needed. This was the case of one of the flagship targets to reverse biodiversity loss: Target 2 to restore at least 15 % of degraded ecosystems in the EU, which also reflected the global Aichi Target and the EU’s commitment under the Convention on Biological Diversity.

Legislative and regulatory instruments are the main tool for environmental policy and have been widely used at EU level. According to SOER 2020 , there are significantly fewer binding targets for biodiversity than for other environment areas, such as climate change, air pollution, waste, and chemicals. When biodiversity policy objectives and targets are not met (as has been the case for several consecutive biodiversity policy instruments), there is a tendency to reiterate them and extend the timeframe for their achievement. SOER 2020 points to six key areas for bold action, one of which is the development of systemic policy frameworks with binding targets to mobilise and guide actions across actors and levels.

It was a clear conclusion of the evaluation, and a view held by a high number of stakeholders consulted that, while voluntary instruments could play an important role in certain contexts, the lack of legislative teeth was a significant factor in the Strategy’s failures in effectiveness and cost-effectiveness. For the operationalisation of the biodiversity targets, the Strategy could have benefited from a different combination of regulatory and market-based instruments. The EP Resolution of January 2020 called upon the Commission to “move away from voluntary commitments and to propose an ambitious and inclusive Strategy that sets legally (and, consequently, enforceable) binding targets for the EU and its Member States".

- ***Clearly formulated, measurable targets.*** Many of the Strategy’s targets and actions were not measurable or specific enough to guide implementation and enable the monitoring of results. For example, challenges to restoration have arisen from the ***ambiguity of the 15 % restoration target***[71]: the ecosystems it referred to[72], how to measure the achievement of the objective[73], unclarity of what restoration activities comprise, and the absence of baseline information to define what 'degraded' ecosystems are.

- ***Knowledge*** (including cooperation and dialogue between policy-makers and science and research stakeholders) is essential for evidence-based decision-making, robust policy development, implementation and monitoring. Gaps in data and monitoring (including on pressures and their impacts on biodiversity) or lack of transparency and access to data have hindered progress in the implementation of the Strategy. At the same time, knowledge needs have been recognized and the Strategy has supported the development and application of common methodologies for the mapping and assessment of ecosystems and their services, and and approaches to reflect the value of biodiversity in decision-making[74].
- ***Clear responsibilities for implementation, co-ordination and cooperation between relevant stakeholders.*** Most stakeholders consulted in the course of the evaluation considered that the Strategy had either 'partially' or 'poorly' engaged stakeholders in implementation, in particular at national/regional levels. Stakeholders noted that the governance of the Strategy had contributed significantly to access to information on the state of biodiversity, yet it has not achieved cooperation and coordinated action across policy areas. Private sector engagement has been regarded as a significant untapped potential to reduce pressures on biodiversity from business activities.
- Last but not least, ***political priority*** given to biodiversity protection and restoration, especially vis-à-vis other policy objectives, is essential for successful implementation.

4. Key lessons and their relevance to the Nature Restoration initiative

1. Effective implementation requires specific, measurable targets with clear definitions, timelines and responsibilities for implementation.

In relation to nature restoration, the proposed EU Nature Restoration Law will set out concrete definitions, targets, timelines and responsibility for implementation.

2. Well-designed biodiversity protection, restoration and sustainable use measures can bring wider environmental and socio-economic benefits

The proposed EU Nature Restoration Law puts a strong emphasis on biodiversity as well as socio-economic benefits for restoration, in particular support to climate mitigation and

[71] European Habitats Forum *Detailed Response to the EU Biodiversity Strategy*, 2011.
[72] Tucker et al., *Estimation of the financing needs to implement Target 2 of the EU Biodiversity Strategy*, Report to the European Commission, Institute for European Environmental Policy, 2013.
[73] European Court of Auditors, Special Report no 13/2020 *Biodiversity on farmland: CAP contribution has not halted the decline*.
[74] *Guidance on the integration of ecosystems and their services in decision-making*.

adaptation, disaster risk reduction and the provision of a range of further ecosystem services.

3. Actions to halt and reverse biodiversity loss needs to cover the range of pressures on all main ecosystem types

The impact assessment for the EU Nature Restoration Law has carefully considered the range of main EU ecosystem types and the feasibility of setting targets that tackle both pressures (passive restoration) and active measures to restore degraded ecosystems. Where sufficient evidence was available, concrete targets have been proposed. Where further research is needed, the legislation includes provisions for strengthened monitoring to collect the evidence needed.

4. A mixture of policy instruments is needed to deliver the biodiversity commitments

The approach to an overarching strategic framework for coherent biodiversity action has been retained in the EU Biodiversity Strategy for 2030. At the same time, a range of policy instruments are envisaged to deliver its commitments, from a new Nature Restoration Law through to strengthened financing and partnerships.

5. A substantial increase of funding is necessary, with a robust tracking system

The EU Biodiversity Strategy for 2030 indicates the scale of funding that needs to be made available for the implementation of the Strategy and sets out measures to meet the implementation funding needs. This is matched by an increased funding ambition for biodiversity in the EU budget for the 2021-2027 period. Legal restoration targets are expected to both strengthen the mainstreaming of measures in support of restoration in EU instruments, and the uptake of such measures at the national level.

6. EU programmes and instruments should be biodiversity-proof to ensure no harm

Nature restoration targets and the need to ensure the sustainability of restored ecosystems will be taken into account in the biodiversity proofing of EU programmes and instruments.

7. A robust biodiversity governance framework is needed to ensure evidence-based policy-making, stakeholder engagement, responsibility for implementation, and robust and transparent monitoring and review mechanisms

The Commission put in place, in 2022, an enhanced governance and monitoring framework for the EU Biodiversity Strategty for 2030.

Lesson 8. Knowledge, awareness, capacities and skills are crucial to support action on biodiversity across all parts of society, sectors and levels

In synergy with other EU instruments, the Nature Restoration Law will encourage actions in the Member States to strengthen knowledge, awareness and skills for restoration.

Lesson 9. Biodiversity loss and climate change are inter-linked and need to be tackled together

The proposed Nature Restoration Law builds on the strong synergies between restoring healthy ecosystems and the benefits they provide for climate mitigation and adaptation.

Annex X: Coherence with EU legislation and policy initiatives related to nature restoration; approach to non-deterioration

This annex includes:

1. Synergies and added value of the Nature Restoration Law with respect to BHD, WFD, MSFD and climate regulation.
2. An overview (table) of policy initiatives and laws that are existing and currently in preparation as well as how they (could) relate to the setting of legally binding restoration targets.
3. The approach to ensure non-deterioration of ecosystems that are in good condition and of those that still need to be restored.

1. Synergies and added value of the Nature Restoration Law with respect to BHD, WFD, MSFD and climate legislation.

Birds and Habitats Directives (BHD):

Based on the arguments presented below, the **added value of the new legislation on restoration** will be:

1) to set a clear **deadline** for achieving good status for species and habitats of EU conservation concern (all birds, habitats and species listed in the Habitats Directive's annexes);
2) to create **explicit restoration obligations** for species and habitats of EU conservation concern outside the Natura 2000 network;
3) to give a **real impetus to restoration in Natura 2000** as well as in other protected areas (30 % voluntary conservation improvement target for both terrestrial and marine set out in EU Biodiversity Strategy);
4) put in place a **strategic restoration** planning by Member States up to 2050, thereby creating a mechanism to achieve good status which would address in a coherent way the restoration needs under the Habitats, Birds, Water Framework and Marine Strategy Framework Directives;
5) to set **restoration targets** for ecosystems not explicitly / comprehensively covered by existing legislation, such as soil, pollinators, urban;
6) to **create strong links with the climate mitigation and adaptation agenda** by requiring Member States to prioritize the most climate relevant restoration, i.e. creating a win-win situation.

The **Birds Directive** aims to protect all wild bird species and their habitats across the EU.

It requires restoration of bird populations to favourable conservation status (FCS)[75] for all 460 species of naturally occurring birds in the wild state in the European territory of the Member States to which the Treaty applies.

However, the Directives' specific provision on restoration mainly relate to the habitats of bird species for which Member States have to classify, protect and conserve Special Protection Areas (part of the Natura 2000 network), which cover 197 species and sub-species listed in Annex I of the directive as well as regularly occurring migratory species not listed in Annex I. Outside Natura 2000, while there is a more general duty under Article 3 of the Directive to maintain or re-establish a sufficient diversity and area of habitats for all 460 species of birds, these provisions are more general and harder to implement/enforce.

The Habitats Directive covers 1200 threatened or endemic species of wild animals and plants, collectively referred to as species of Community interest (listed in its Annexes II, IV and V), as well as 233 rare habitat types, listed in its Annex I.

The Habitats Directive requires restoration to FCS for all habitat types and species of Community interest. However, its specific provisions on restoration relate to Annex I habitats as well as habitats of the species listed in Annex II within Special Areas of Conservation (part of the Natura 2000 network). Outside Natura 2000, there is no specific provision on restoration for habitat and species of Community interest, albeit the achievement of the directive's objective would require restoration to happen.

The Natura 2000 network on land currently covers 18 % of the EU surface, ranging from 8,3 % in Denmark to 36,7 % in Croatia, which reflects differences in biodiversity richness but also different designation strategies by the MS. The network covers approximately 34 % of the surface of all Annex I habitat types, which means that about two thirds lies outside.

Therefore, it can be concluded that – as regards the Habitats and Birds directives - the areas for which there is no specific provision on restoration cover all land and sea that do not fall within Natura 2000 sites, i.e. the majority of the EU territory, large parts of which are undergoing continuous degradation (EU Ecosystem Assessment 2020).

Moreover, since the Birds and Habitats Directive do not specify a deadline by which FCS shall be reached, the pace of implementation of measures towards this goal has been very slow; action has been concentrated in setting up Natura 2000 sites and to date it has been mainly linked to protection of the habitats and species in the sites, rather than to their restoration.

[75] The Environmental Liability Directive (Directive 2004/35/EC of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage) has de facto equated the Birds Directive objective to the one of the Habitats Directive, as it applies the concept of favourable conservation status (FCS) to birds, too.

Although protection and restoration of habitats (e.g. peatlands) under the Birds and the Habitats Directive will benefit soil health and soil biodiversity, this is not an explicit objective of the Directives. Furthermore, although some pollinators are protected under the Habitats Directive (e.g. rare butterfly species) and they also benefit from habitat conservation measures (e.g. for grasslands) they are not a particular focus of the Nature Directives. Finally, there is no EU legislation requiring the restoration of urban ecosystems.

Water Framework Directive (WFD) and Marine Strategy Directive (MSFD)

The Nature Restoration Law proposal and in particular the freshwater and a marine targets will

- Support an **acceleration** of the implementation of both the MFSD and the WFD;
- Can cover topics which go **beyond** the direct scope of application of both the MFSD (fine grained detail for several marine habitats) and the WFD (free flowing rivers, connectivity with riverine habitats, and small water bodies);
- Support efforts to secure a **more frequent and regular** monitoring of the actual state of biodiversity, in line with the more frequent and regular monitoring promoted under the 8th EAP and, more recently, under the Zero Pollution Action Plan too.

The fact that MS would have to set out National Restoration Plans on how to reach the above targets, further requirements to address key pressures on both marine and freshwater ecosystems can be introduced. These can accelerate the implementation of both the MFSD and the WFD – paving the way for a more ambitious approach to both MFSD and WFD targets, notably beyond the, respectively, 2020 and 2027 legal deadlines for achieving good status for all seas, rivers and lakes, transitional and coastal water bodies.

<u>Marine environment:</u>

In the future in particular for **marine species**, the legal proposal can pave the ground for a much more granular monitoring of data on all these species, allowing to set targets for species in a second step, as soon as Member States will have collected sufficient data. In this context, synergies will be sought with the upcoming “Action plan to conserve fisheries and conserve marine ecosystems”, which builds on the Technical Measures report adopted last September and which will, among a variety of actions, focus on certain individual species. Habitats (for example seagrass beds) harbour an abundant variety of species. Protecting habitats therefore has the added value of restoring both ecosystems as well as those (non-resident) species that rely on these habitats. Habitats are more easily monitored and progress can be registered over a short-medium period of time. Focusing on restoring them as a first step makes sense.

Also in the future there is a possibility to turn the indicators used to achieve the marine targets into indicators to achieve Good Environmental Status under the MFSD. Progress towards achieving the restoration targets could thus feed into progress under the MSFD.

There are also synergies in terms of better cross-linking the reporting on restoration efforts (hence better integrate the policy objectives) under the MSFD, WFD and HD to be able to tell a comprehensive story of marine environmental protection.

Freshwater environment

The targets proposed for “Rivers, lakes and riverine/alluvial habitats” would stimulate synergistic for the WFD. In particular, the restoration target in the form of a requirement to map and, where possible, remove obsolete barriers, as an opportunity to:

- accelerate the implementation of the WFD;
- help to maintain good status / non deterioration after 2027.

Achieving WFD objectives will in itself contribute to the 2030 BD target (considering that 20 out of 32 Annex I Habitats Directive categorised as “rivers, lakes and alluvial habitats” are rivers and lakes), and will contribute to the 2050 BD target by enabling a prioritisation of barriers to be removed. The prioritisation will build upon the systematic approach taken under the WFD, enabling to identify

1) barriers justified under Art 4(3) WFD;

2) barriers in natural river water bodies and measures required to achieve good status (possibly but not necessarily taking down barriers) and

3) barriers whose removal can be carried out in the most cost effective manner, to achieve high status/free flowing rivers and create floodplains to the benefit of ecosystems outside, yet directly dependent on, water bodies.

Similarly, the requirement to map out smaller water units, which may not be part of the WFD delineated water bodies, to verify how severely they have been impacted, the primary pressures and the current conditions they are in, can help pave the way towards setting specific restoration targets in a second stage, and ultimately could play a critical role in meeting the EU restoration policy objectives by 2050, by closing existing data gaps of unmapped and unknown habitats and conditions.

Climate Legislation

Enabling effective implementation will also be supported by establishing effective synergies with climate legislation.

A specific opportunity is the review of the Regulation on land use, land-use change and forestry (LULUCF). This work would develop monitoring requirements on LULUCF emissions and removals, particular from high carbon stock land, land under protection or restoration provisions, and land with high climate risk, and explicitly link to the land definitions in environmental legislation. This would in the longer term enable cross referencing between land-based climate change mitigation, and adaptation, disaster risk reduction and ecological condition. This would lead to better cross correspondence between climate law and the restoration law in the longer term.

A related opportunity is the forthcoming mandatory requirement to ensure progress in adaptation to climate change under Article 4 of the EU Climate Law, to adopt and implement national adaptation strategies and plans, and to promote nature-based solutions and ecosystem-based adaptation.

2. Overview of links and synergies with EU legislation and policy initiatives

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
EU Directives, Regulations and Decisions			
Birds and Habitats Directives[76]	Existing	• HD Article 2(2) requires that measures taken pursuant to the HD shall be designed to maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of Community interest (habitats listed in Annex I and species listed in Annex II and/or IV or V). However, it does not set a deadline or timeframe for achieving this objective. • According to HD Article 3, Natura 2000 shall enable the natural habitat types and the species' habitats concerned to be maintained or, where appropriate, restored at a favorable conservation status in their natural range. • HD Article 10 furthermore states that MS shall in their land-use planning and development policies encourage the management of landscape features with the aim of improving connectivity within the N2000 network. • HD Article 6 is the key provision governing the protection and the management of Special areas of conservation. In particular: o HD Article 6(1) states for special areas of conservation, MS shall establish the necessary conservation measures involving, if need be, appropriate management plans specifically designed for the sites or integrated into other development plans, and appropriate statutory, administrative or contractual measures which correspond to the ecological requirements of the natural habitat types in Annex I and the species in Annex II present on the sites. o HD article 6(2) states that MS shall take appropriate steps to avoid, in the special areas of conservation, the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas	• Definition of good ecosystem status under NRL has to be aligned with favourable conservation status (FCS) under BHD. • NRL will support delivering the voluntary target in the BS2030 that habitats and species show no deterioration in conservation trends and status and at least 30 % reach favourable conservation status or at least show a positive trend. • Restored ecosystems outside Natura 2000 under NRL could be designated as (strictly) protected areas thus contributing to the relevant BDS2030 targets. • The NRL will complement the BHD by: (1) setting a deadline for achieving FCS for birds, Annex I habitats and species listed in Annex II and/or IV or V, which is missing in both the Birds and Habitats Directives; (2) creating more explicit restoration obligations for Annex I habitats and habitats of birds and species listed in Annex II and/or IV or V outside of the Natura 2000 network; (3) putting in place the mechanism to achieve FCS, e.g. by requiring MS to prepare restoration plans; and (4) creating links with the climate change policy, e.g. by requiring Member States to restore carbon and nature rich habitats.

[76] Birds Directive: EUR-Lex - 32009L0147 - EN - EUR-Lex (europa.eu), Habitats Directive: EUR-Lex - 01992L0043-20130701 - EN - EUR-Lex (europa.eu)

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
		have been designated, in so far as such disturbance could be significant in relation to the objectives of this Directive. • The BD requires restoration to FCS for all species of naturally occurring birds in the wild state in the European territory of the Member States to which the Treaty applies. This shall be achieved by means of protection, management and restoration of species and their habitats across the territory of the Member States, as well as in Special Protection Areas (SPA) for certain bird species. • By virtue of article 7 of the HD, obligations arising under Article 6 (2) (and (3) and (4)) of the HD also apply to SPA classified under the BD.	
Water Framework Directive (WFD)[77]	Existing	• Establishes a framework for the protection of inland surface waters (including rivers, lakes, transitional waters, coastal waters) and groundwater which i.a. prevents further deterioration and protects and enhances the status of aquatic ecosystems.	• The NRL definition of good ecosystem condition does not duplicate, nor substitute the 2027 target of good status for all water bodies under WFD; it rather complements it. • In line with the BDS2030, the NRL targets on freshwater ecosystems reinforce and work in synergy with the targets of the WFD (achieve good ecological status for all water bodies by 2027) • NRL targets contribute to accelerate the implementation of WFD and reinforce the synergies between WFD and the nature legislation. • NRL requirement on non-deterioration would match the existing WFD requirement to take measures to prevent deterioration of the status of all bodies of water
Marine Strategy Framework Directive (MSFD)[78]	Existing	• Establishes a framework within which Member States shall take the necessary measures to reach the target of achieving or maintaining good environmental status in the marine environment by the year 2020 at the latest.	• Definition of good ecosystem status under NRL aligned with good environmental status under MSFD. • The MSFD implementation of Art.13 (and the ongoing MSFD review) may consider the NRL targets as measures to achieve good environmental status.

[77] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy EUR-Lex - 32000L0060 - EN - EUR-Lex (europa.eu)

[78] Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy EUR-Lex - 32008L0056 - EN - EUR-Lex (europa.eu)

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
		• Requires MS to develop marine strategies that protect and preserve the marine environment, prevent its deterioration or, where practicable, restore marine ecosystems in areas where they have been adversely affected.	• NRL targets reinforce existing MSFD targets (and do not create a derogation from the deadline/ambition). • NRL targets focus on the maintenance of ecological functions at a higher resolution than the normal management/reporting scales under the MSFD, ensuring consistency and synergy of the policy objectives.
Marine Spatial Planning Directive (MSPD)[79]	Existing	• Requires MS to consider i.a. environmental aspects to support sustainable development and growth in the maritime sector, applying an ecosystem-based approach. • Requires MS to set up marine spatial plans that consider interactions of activities and uses and contribute to i.a. the preservation, protection and improvement of the environment, including resilience to climate change impacts.	• NRL could provide concrete objectives and measures to apply the ecosystem-based approach enshrined in the MSPD • The links between NRL and marine protected areas could provide more certainty and usefulness to the spatial plans
Floods Directive (FD)[80]	Existing	• Establishes a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for i.a. the environment.	• NRL reinforces FD because the restoration of the ability of marine and freshwater ecosystems to provide regulating services, such as natural water retention, could help prevent and mitigate the effects of floods (climate adaptation). • Also, healthy ecosystems are more resilient to the effects of severe floods.
Climate Law	Existing (Regulation 2021/1119 of 30 June 2021).	• Establishes a framework for the irreversible and gradual reduction of greenhouse gas emissions and enhancement of removals by natural or other sinks in the Union. • Sets a legally binding target of net zero greenhouse gas emissions (climate neutrality) by 2050 and negative emissions thereafter. • Introduces a new EU target for 2030 of reducing net greenhouse gas emissions by at least 55 %, compared to 1990. This includes the review and possible revision of climate and	• NRL, by focusing on restoring ecosystems with a high potential for climate adaptation/mitigation (e.g. through carbon removals), will contribute to achieving Climate Law targets. • The Climate Law contributes to the NRL by strengthening EU policies on climate change (both mitigation and adaptation), which is a major pressure on biodiversity loss. • The Climate Law acknowledges the role of ecosystem restoration in maintaining, managing and enhancing natural sinks and promoting biodiversity (consideral 23).

[79] Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning EUR-Lex - 32014L0089 - EN - EUR-Lex (europa.eu)

[80] Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks EUR-Lex - 32007L0060 - EN - EUR-Lex (europa.eu)

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
		energy laws to be able to achieve this updated target (fit for 55 package). • Requires MS to develop and implement adaptation strategies to strengthen resilience and reduce vulnerability to the effects of climate change. • Strengthens existing provisions on adaptation to climate change. • Establishes a framework for achieving progress in pursuit of adaptation goals, in a consistent manner in all policy areas, including biodiversity (in particular nature-based solutions).	• Under the Climate Law, Member States shall promote nature-based solutions and ecosystem-based adaptation.
Climate Governance Regulation[81]	Existing	• Specifies common rules on the planning, monitoring and the reporting of climate action, in particular emissions and removals associated to land use, land-use changes and forestry.	• The review of the LULUCF Regulation proposes to introduce high-level monitoring provisions for land with high carbon stock, land under restoration, land under protection and land with high climate risk. • The NRL would allow to amend this list, when restoration targets will be clarified.
Environmental Impact Assessment Directive (EIAD)[82]	Existing	• Requires 'developers' to do an environmental impact assessment for a wide range of defined public and private projects, and covers impacts on biodiversity, with particular attention to species and habitats protected under BHD.	• The potential NRL requirements for non-deterioration and to identify, describe, assess and disclose the impacts of (new) sectoral policies likely to exacerbate ecosystem degradation processes, could be aligned with the EIA Directive. • NRL could say that assessment of project-level impacts needs to be done according to the EIAD where this could apply, including for interests that go beyond the species/ habitat protected under the BHD.
Strategic Environmental Assessment	Existing	• Examines the likely environmental impacts of certain plans or programmes in order to take them into account in the decision-making process, with the aim of achieving a high-	• The potential NRL requirements for non-deterioration and to identify, describe, assess and disclose the impacts of (new) sectoral policies likely to exacerbate ecosystem degradation processes, could be aligned with the SEAD.

[81] Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action EUR-Lex - 32018R1999 - EN - EUR-Lex (europa.eu)

[82] Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment EUR-Lex - 32011L0092 - EN - EUR-Lex (europa.eu)

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
Directive (SEAD)[83]		level protection of the environment and to promote sustainable development.	Restoration plans under the NRL themselves would also require SEAD.
Eel Regulation No 1100/2007[84]	Existing	• Sets a framework for the recovery of the European Eel.	• NRL will greatly help in the restoration of eel habitats (in particular in river and coastal areas) and ultimately in the recovery of eels.
Common Fisheries Policy (CFP)[85]	Existing	• Lays out rules and guidance on the conservation, management and sustainable exploitation of living aquatic resources. • The CFP provides a framework for the conservation of marine biological resources and the management of fisheries and fleets exploiting those resources; it aims to ensure that fishing and aquaculture activities are environmentally sustainable in the long-term and consistent with achieving socio-economic benefits.	• NRL marine targets could contribute to achieve sustainable fishing.
Common Agricultural Policy (CAP)	Existing (renewal being negotiated)	• To reach the MFF/NextGen target to spend 30 % on climate objectives, 40 % of CAP spending must be dedicated towards these objectives. If CAP budget will be spent on e.g. carbon removals, this would contribute to achieving the NRL targets.	• Possible NRL targets on agroecosystems may also be addressed by the CAP, e.g. in terms of crop diversity, nutrient balance, fertiliser use, pesticide use and risk reduction. Depending on the target some indicators might be available under CAP monitoring. • NRP might introduce additional targets/indicators on agroecosystems that supplement requirements in the coming CAP to further improve the balance between farming and nature. For such cases, CAP might not provide the framework for monitoring and evaluation.
Environmental Accounts Regulation (EAR)	Incoming	• Proposes a new ecosystem accounting module providing legal definitions of ecosystem extent, ecosystem condition, conversion and ecosystem services, as well regular reporting on these by MS.	• Definitions under EAR and NRL are streamlined where beneficial.

[83] Assessment of the certain effects of plans and programmes on the environment Directive 2001/42/EC of the European Parliament and of the C... - EUR-Lex (europa.eu)

[84] Council Regulation (EC) No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel EUR-Lex - 32007R1100 - EN - EUR-Lex (europa.eu)

[85] Common fisheries policy (CFP) (europa.eu)

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
Environmental Liability Directive (ELD)[86]	Existing	• Establishes a framework of environmental liability, i.a. to prevent and/or remedy environmental damage to water, protected species and natural habitats (both within and outside N2000 under certain circumstances, as confirmed by the Commission Guidelines/Notice on environmental damage in paragraph 90) through restoration of the environment to its baseline condition - in case of strict/fault-based liability.	• The potential NRL requirements might contribute to knowledge of baseline conditions through monitoring, and knowledge of remediation techniques through methodological provisions on restoration. • ELD establishes a precedent of legally binding prevention and restoration obligations outside N2000. • "Environmental damage" under ELD includes not only damage to Annex I habitats themselves but impairments of the "natural resource services" that they provide. As paragraph 42 of the Notice notes, these can include carbon services and flood protection.
LULUCF Regulation 2021-2030	Existing (Regulation 2018/841)	Establishes a non-debit rule at MS level, Require that all land categories contribute to the reduction of emissions and the enhancement of removals. • MS forest reference levels should be consistent with the objective of contributing to the conservation of biodiversity.	MS have published national forest accounting plans, which, among other, explains how forest reference levels are consistency with biodiversity conservation objective.
LULUCF Regulation 2021-2030 (525/2013) proposal	Existing COM (2021) 554 final	• Strengthen LULUCF objectives at EU and MS level. • Compliance reports shall include an assessment of synergies between mitigation and biodiversity. • Maps and monitors certain habitats relevant for restoration. • Potential co-benefits for restoration in terms of carbon sinks in the land use sector.	• Monitoring requirements are being streamlined (through amendments to the Governance Regulation). NRL will be able to update the elements introduced by the LULUCF Regulation Review. • LULUCF targets will push Member States to enhance natural carbon sinks. • Compliance reports will assess synergies between climate and biodiversity
8th Environmental Action Programme (Commission proposal for a Decision of the	Being adopted, provisional agreement reached by co-legislators on December 1, 2021	• Legal framework that guides environmental and climate policymaking and implementation until 2030. • Includes a policy objective to i.a. restore biodiversity. • Lists potential indicators that overlap with the NRL (common birds, grassland butterflies, fish stock, and land take or soil cover/ sealing). • Potential co-benefits for restoration.	• The foreseen 8th EAP headline indicator set should be coordinated with the indicators and monitoring foreseen in the NRL, to ensure overall coherence and reduction of administrative burden.

[86] Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage CL2004L0035EN0040010.0001.3bi_cp 1..1 (europa.eu)

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
EP and Council)[87]			
Taxonomy Regulation[88] Delegated acts on (1) biodiversity and ecosystems, (2) Climate Adaptation and (3) Mitigation	Existing and Incoming, 2021. Climate delegated act (Del Reg 2021/2139)	• It outlines criteria for activities so that they substantially support at least one of six areas (incl. biodiversity and ecosystems) without doing any significant harm to another. • Economic activities qualifying as environmentally sustainable will support reaching the NRL targets for protection and restoration of ecosystems. • Restoration of wetlands (including peatlands) is identified as a sustainable investment under the EU Taxonomy Regulation Climate Delegated Act.	• The Taxonomy Regulation and its Delegated Act defines technical screening criteria for sustainable activities, including o Biodiversity DNSH criteria for activities with a significant contribution to climate change mitigation or adaptation o Mitigation and adaptation DNSH criteria for activities with a signification contribution to biodiversity and ecosystem restoration.
Legislation and guidance on green public procurement (to boost NBS)[89]	Incoming, 2022	• The existing EU GPP sets criteria to facilitate the inclusion of green requirements in public tender documents with the aim to reach a good balance between environmental performance, cost considerations, market availability and ease of verification. • Potential co-benefits for restoration when environmental performance criteria reduce pressures on biodiversity.	
Invasive Alien Species (IAS) Regulation[90]	Existing	• Invasive alien species (IAS) generally cause damage to ecosystems, reduce their resilience, including to climate change and affect (mostly negatively) the ecosystem services provided. • Degraded ecosystems are particularly prone to the establishment of IAS. Many IAS thrive particularly in heavily modified, ecologically degraded environments. • The IAS Regulation calls for undertaking proportionate restoration measures to strengthen the ecosystems' resilience towards invasions and to repair the damage caused.	• The list of IAS of Union concern was updated the last time in 2019 and currently includes 36 plants and 30 animals. A new update of the list is currently under preparation. The species listed are to be addressed as a priority across the Union. As these may negatively affect a wide range of ecosystems, whether terrestrial, aquatic or marine, implementation of the measures foreseen under the IAS Regulation contribute to the objectives of the NRL. • On the other hand, the NRL can be expected to contribute to achieving the objectives of the IAS Regulation as ecosystem restoration often requires the removal of invasive alien species.

[87] Decision of the European Parliament and of the Council on a General Union Environment Action Programme to 2030. 8EAP-draft.pdf (europa.eu)

[88] EU taxonomy for sustainable activities | European Commission (europa.eu) EU Taxonomy Climate Delegated Act: EUR-Lex - C(2021)2800 - EN - EUR-Lex (europa.eu)

[89] Case studies and recommendations: Public procurement of nature-based solutions - Publications Office of the EU (europa.eu)

[90] Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species EUR-Lex - 32014R1143 - EN - EUR-Lex (europa.eu)

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
		• Article 20 of the IAS Regulation requires Member States to "carry out appropriate restoration measures to assist the recovery of an ecosystem that has been degraded, damaged, or destroyed by invasive alien species of Union concern unless a cost-benefit analysis demonstrates, on the basis of the available data and with reasonable certainty, that the costs of those measures will be high and disproportionate to the benefits of restoration. • Article 20 further specifies that these restoration measures shall include at least the following: (a) measures to increase the ability of an ecosystem exposed to disturbance caused by the presence of invasive alien species of Union concern to resist, absorb, accommodate to and recover from the effects of disturbance and (b) measure to support the prevention of reinvasion following an eradication campaign. • Article 21 of the Regulation states that, in accordance with the polluter pays principle Member States shall aim to recover the costs of measures needed to prevent, minimise or mitigate the adverse impacts of invasive alien species, including environmental and resources costs as well as the restoration costs.	Restored, healthy ecosystems can reduce the risk of establishment of new IAS and reduce their spread in the case of already established ones. • A pre-requisite for ecosystems to qualify as restored under the NRL could be that IAS are removed or controlled so that they don't significantly alter their main structure and function.
National Emission reduction Commitment Directive (NECD)[91]	Existing	• Sets national reduction commitments for the periods 2020-29 and 2030 onwards for a range of air pollutants that affects ecosystems and biodiversity negatively and contributes to off-setting restoration efforts through eutrophication, acidification and tissue damage. • NECD helps reduce pressures on biodiversity loss, thereby also contributing to the foreseen non-deterioration requirement under the NRL.	

[91] Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC EUR-Lex - 32016L2284 - EN - EUR-Lex (europa.eu)

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
Regulation on deforestation-free products[92]	Existing	• This Regulation does not cover restoration but focuses on minimising deforestation and forest degradation. • It aims to guarantee that the products that EU citizens consume on the EU market do not contribute to deforestation and forest degradation within the EU and globally.	
EU strategies, programmes or initiatives			
European Green Deal[93]	Existing	• Key elements of the European Green Deal depend on or contribute to the restoration of ecosystems, including the BDS2030, Farm to Fork Strategy, the climate-neutrality ambition by 2050 and the increased climate ambition by 2030, the new EU Climate Adaptation Strategy, the zero pollution ambition/action plan, the Chemicals Strategy for Sustainability, the Circular Economy Action Plan, and the Just Transition Mechanism. Also relevant are the new EU Forest Strategy and the new EU Soil Strategy.	• NRL contributes to various elements of the Green Deal, which are specified in separate rows dedicated to these elements.
Mid-term review and final evaluation of the Biodiversity Strategy to 2020[94]	Existing	• Provides lessons learned related to restoration.	• The following lessons learnt have informed the NRL development: (1) successful local examples demonstrate the feasibility of, and the benefits from restoration, (2) reliance on voluntary instruments alone proved insufficient to mobilise coordinated restoration action of sufficient scale; (3) targets need to be specific enough to guide implementation and monitoring, and backed by clear definitions; (4) insufficient funding is a major barrier to restoration; and (5) an EU-wide monitoring effort is necessary to fill knowledge gaps. For more information see Annex IX.

[92] Proposal for a regulation on deforestation-free products (europa.eu), 17 November 2021

[93] A European Green Deal | European Commission (europa.eu)

[94] Report from the Commission to the European Parliament and the Council the mid-term review of the EU Biodiversity Strategy to 2020 EUR-Lex - 52015DC0478 - EN - EUR-Lex (europa.eu); Trinomics B.V. (2021) Support to the evaluation of the EU Biodiversity Strategy to 2020, and follow-up: Final study report (Publications Office of the EU, 2022) (For a summary of main relevant findings: see Annex IX). The Commission Report on the evaluation of the EU Biodiversity Strategy to 2020 due in April 2022.

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
Biodiversity Strategy for 2030 (BDS2030)[95]	Existing	Contributes to restoration through I.a. the following commitments: • Legally binding targets to be proposed in 2021. • No deterioration of any protected habitats and species by 2030 - trend to be positive for at least 30 %. • Organic farming: 25 %. • Landscape features: 10 %. • 50 % reduction of use and risk of chemical pesticides. • 3 billion trees planted. • Reverse decline in pollinators. • Restore 25 000 km free flowing rivers . • New Urban Greening Platform: the Green City Accord. • Invasive alien species: half the number on the red list. • Reduction of pollution from fertilisers. • Reduction of damage to seabed, bycatch.	• NRL contributes to achieving the headline ambition to ensure that by 2050 all of the world's ecosystems are restored, resilient, and adequately protected, and that Europe's biodiversity is on the path to recovery by 2030. • NRL contributes to delivering on the commitment to propose legally binding targets. • NRL goes beyond the BDS2030 by including a non-deterioration requirement not only for HD Annex I habitats and habitats of protected species and within/outside N2000, but also for ecosystems beyond any protection (e.g. those not covered by HD Annex I habitats and habitats of protected species).
Farm to Fork Strategy (F2F)[96]	Existing	Includes targets that have the potential to contribute to restoration by reducing pressures on biodiversity resulting from food production: • Reduce the overall use and risk of chemical pesticides by 50 % and the use of more hazardous pesticides by 50 % by 2030. • Reduce nutrient losses by at least 50 %, while ensuring that there is no deterioration in soil fertility. This will reduce the use of fertilisers by at least 20 % by 2030. • Halve per capita food waste at retail and consumer levels by 2030 (which is to be legally binding once data/baselines become available in 2022). Contributes to restoring agro and marine ecosystems, if done right, through the following: • Target that at least 25 % of the EU's agricultural land is under organic farming by 2030 and a significant increase in organic	• As regards the agriculture related targets of F2F, COM invited MS, in their CAP Strategic Plan, to set explicit national values for those targets, taking into account its specific situation and recommendations. • The reduction of pressures under F2F helps reduce (further) deterioration and thereby decrease the totality of needed restoration. • The requirement of no deterioration in soil fertility under F2F and the non-deterioration requirement under NRL will strengthen one another. • Restoration targets for agro-ecosystems under NRL need to be considered in transition efforts to organic farming under F2F. • The organic action plan under F2F (including the use of CAP interventions) does not include targets that are legally binding target, which can be addressed by the NRL.

[95] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: EU Biodiversity Strategy for 2030 Bringing nature back into our lives (20 May 2020). EUR-Lex - 52020DC0380 - EN - EUR-Lex (europa.eu)
[96] A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system COM/2020/381 final (20 May 2020) EUR-Lex - 52020DC0381 - EN - EUR-Lex (europa.eu)

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
		aquaculture (which means the environmental status and biodiversity health needs to be improved). • Commitment to bring fish stocks to sustainable levels by applying zero tolerance in the fight against illegal, unreported and unregulated fishing (IUU) and combat overfishing, promote sustainable management of fish and seafood resources and strengthen ocean governance, marine cooperation and coastal management'. • EU carbon farming initiative under the Climate Pact will promote a new green business model based on climate benefits such as carbon sequestration.	• F2F seeks to enforce existing rules and modify the demand side but does not foresee direct restoration activities e.g. establishing no-take zones. NRL can address this gap. • The promotion of business models for carbon sequestration under F2F would support the achievement of targets related to soils under NRL. • Ecosystem restoration under NRL will contribute to the F2F goals by increasing the health of ecosystems that provide services and resilience to the benefit of the food system.
Zero Pollution Action Plan[97]	Existing	• Contributes to restoration by mitigating pollution as a pressure on biodiversity loss, by initiating actions to better prevent, monitor and remedy pollution from air, water, soil and consumer products.	• NRL contributes to monitoring and remedying pollution, including from soil.
Circular Economy Action Plan[98]	Existing	• Sets out a plan to reach a climate-neutral circular economy. More circular natural resource use (e.g. electronics, packaging, plastics, textiles, construction material) can contribute to restoration e.g. by mitigating pressures on biodiversity loss resulting from land use for extracting and processing materials, fuels and food. • Sets out the objective to significantly reduce total waste generation and halve the amount of residual (non-recycled) municipal waste by 2030, i.a. by developing methodologies to minimise the presence of substances that pose problems to heatlh or the environment in recycled materials and articles made thereof. • Mentions that the development of a regulatory framework for certifying carbon removals will be explored to incentivise the uptake of carbon removal and increased circularity of carbon, in full respect of the biodiversity objectives. This can	

[97] Pathway to a Healthy Planet for All EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil' (12 May 2021) EUR-Lex - 52021DC0400 - EN - EUR-Lex (europa.eu)

[98] A new Circular Economy Action Plan For a cleaner and more competitive Europe (11 March 2020) EUR-Lex - 52020DC0098 - EN - EUR-Lex (europa.eu)

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
		contribute to restoration when carbon removal and storage are nature based, e.g. through restoration of ecosystems, forest protection, afforestation, sustainable forest management and carbon farming/sequestration. • Announces a regulatory framework for certifying carbon removals based on robust and transparent carbon accounting to monitor and verify the authenticity of carbon. • The initiatives under the Circular Economy Action Plan promotes the uptake of carbon removal and increased circularity of carbon in respect of the biodiversity objectives, thereby reducing pressures on biodiversity loss.	
Chemicals strategy for sustainability towards a toxic-free environment (CS)[99]	Existing	Outlines i.a. the following actions related to chemical pollution in the natural environment: • Proposes new hazard classes and criteria in the CLP Regulation to fully address environmental toxicity, persistency, mobility and bioaccumulation. • Ensure that the information made available to authorities on substances allows comprehensive environmental risk assessments by strengthening requirements across legislation • Address the impact on the environment of the production and use of pharmaceuticals in the upcoming pharmaceuticals strategy for Europe. • Support research and development for decontamination solutions in terrestrial and aquatic environments. • Reinforce the regulation of chemical contaminants in food to ensure a high level of human health protection. • CS helps reduce the pressures on biodiversity loss of chemical pollution (e.g. in soils), thereby also contributing to the foreseen non-deterioration requirement under the NRL.	

[99] Chemicals Strategy for Sustainability Towards a Toxic-Free Environment (14 October 2020) Strategy.pdf (europa.eu)

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
Green Infrastructure Strategy[100]	Existing	• The Natura 2000 network is at the core of the EU's Green Infrastructure (GI) strategy. Additional measures through GI deployment, including GI projects at EU level, would improve the network's coherence and would help achieve the objectives of nature directives aiming to maintain or restore at favourable conservation status for all species and habitats of Community importance, while at the same time contribute to other targets of the BDS2030. • Depending on the local situation, GI deployment will therefore require both the conservation of existing biodiverse ecosystems in good ecosystem condition, as well as the restoration of degraded ecosystems.	• National Restoration Plans put in place by MS could take into account Green Infrastructure deployment. GI projects will also help achieve the objectives of the NRL, if biodiversity principles are followed.
Sustainable Carbon Cycles communication	Existing (COM (2021) 800 final)	• The Communication sets out short- to medium-term actions to support carbon farming and upscale this green business model to better reward land managers for carbon sequestration and biodiversity protection. By 2030, carbon farming initiatives should contribute 42Mt of CO2 storage to Europe's natural carbon sinks. Measures to achieve this goal include: o promoting carbon farming practices under the Common Agricultural Policy (CAP) and other EU programmes such as LIFE and Horizon Europe's "Soil Deal for Europe" research mission, and through national public financing and private finance; o standardising the monitoring, reporting and verification methodologies needed to provide a clear and reliable certification framework for carbon farming, allowing for developing voluntary carbon markets; o provide improved knowledge, data management and tailored advisory services to land managers, both on land and within blue carbon ecosystem.	• NRL will include targets that can also be contribute to carbon farming, increasing carbon sequestration while often providing important co-benefits for biodiversity and other ecosystem services. Although very site-dependent in application, the following are effective examples of improved land management practices: o Afforestation and reforestation that respect ecological principles favourable to biodiversity and enhanced sustainable forest management including biodiversity-friendly practices and adaptation of forests to climate change; o Agroforestry and other forms of mixed farming combining woody vegetation (trees or shrubs) with crop and/or animal production systems on the same land; o Use of catch crops, cover crops, conservation tillage and increasing landscape features: protecting soils, reducing soil loss by erosion and enhancing soil organic carbon on degraded arable land; o Targeted conversion of cropland to fallow or of set-aside areas to permanent grassland;

[100] Green Infrastructure (GI) — Enhancing Europe's Natural Capital (6 May 2013) EUR-Lex - 52013DC0249 - EN - EUR-Lex (europa.eu)

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
		• The Communication also aims to develop blue carbon initiatives, as using nature-based solutions on coastal wetlands and regenerative aquaculture.	o Restoration of peatlands and wetlands that reduces oxidation of the existing carbon stock and increases the potential for carbon sequestration. • NRL will also include targets which are effective carbon removal solutions ensuring no negative impact on biodiversity or ecosystem deterioration in line with the precautionary and Do No Significant Harm principles. • NRL will benefit of the the carbon farming challenge: every land manager should have access to verified emission and removal data by 2028 to enable a wide uptake of carbon farming;.
EU Pollinators Initiative[101]	Existing	• Aims to address the decline of pollinating insects, a key structural and functional component across different types of terrestrial ecosystems (agro-ecosystems, forests, wetlands, heathland and scrubs). Restoration of such ecosystems would not be possible without restoration of pollinator populations. • Sets actions to tackle the major causes of pollinator decline, which are at the same time key pressures on ecosystems, such as land use (change), agriculture, pesticides, environmental pollution, invasive alien species.	• There is no overlap, only complementarity and synergies. The NRL would strengthen the Initiative by providing a legal character to its critical elements (overarching objective, monitoring). • The Initiative is currently developing a monitoring system and indicators for pollinators which can be used to set a baseline/target on pollinators and a monitoring obligation under the NRL. • The Initiative's action framework will steer and guide the development of the NRP under the NRL.
Climate Adaptation Strategy[102]	Existing	• Sets out how the European Union can adapt to the unavoidable impacts of climate change. and become climate resilient by 2050. • Proposes actions that push the frontiers of knowledge on adaptation so that we can gather more and better data on climate-related risks and losses. • Promotes nature-based solutions for adaptation • Promotes carbon farming as a new green business model based on climate benefits such as carbon sequestration (CO_2-removal from atmosphere). "Through carbon farming, the Commission will promote a new business model for land-based carbon	• NRL 2050 target that all EU ecosystems are restored by 2050 reinforces the CAS 2050 climate resilience target, and vice versa. • MS can use CAS data on climate-related risks and losses when determining restoration priorities. • NRL contributes to CAS because restoration can be done in a way that it is a NBS for adaption. • NRL will include targets that can also be considered as nature-based solutions for adaptation

[101] EU Pollinators Initiative (1 June 2018) EUR-Lex - 52018DC0395 - EN - EUR-Lex (europa.eu)

[102] Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change (24 February 2021) EUR-Lex - 52021DC0082 - EN - EUR-Lex (europa.eu)

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
		removals, including financial incentives to rollout nature-based solutions".	
Updated Soil Strategy[103]	Existing	• Sets out a number of initiatives to encourage voluntary action by MS. Possible actions including (1) providing support to MS in drafting national action plans to achieve land degradation neutrality; (2) recommending MS to address degraded soil in the context of the CAP; (3) providing guidelines on afforestation and close to nature forestry as means to restore degraded soil; and (4) outlining what is needed/expected in the NRL. • Proposes to tabling a Soil Health Law including measures to achieve good soil health by 2050.	• Soil Strategy outlines what is necessary in the NRL to achieve soil-related objectives. • The Soil Health Law announced in the Soil Strategy (and subject to impact assessment) will contribute to restoring ecosystems, in particular by improving soil health. • NRL binding requirements will substantially contribute to soil objectives, e.g. in light of soil health and soil biodiversity being insufficiently addressed by existing legislation. • Soil Strategy actions will complement and help achieve the NRL targets, and vice versa. • Indicators and monitoring in the Soil Strategy and NRL are aligned.
New Forest Strategy (FS)[104]	Existing	• Promotes restoration of damaged forests addressing climate change adaptation (e.g. developing an EU framework/guidance) based on best available knowledge and practices, including on biodiversity friendly afforestation and restoration. • Includes measures for strengthening forest protection and restoration and improving and harmonising the planning and monitoring of EU forests. • Provides a roadmap for planting at least 3 billion additional trees by 2030. • Facilitates existing EU financing mechanisms, explores the potential of EIB funds, and provides financial incentives for forest owners and managers for improving the quantity and quality of EU forests (protection and restoration). • (still under discussion): "The Commission will also "encourage MS to design an ecoscheme for forest protection, restoration, […] and develop guidance to pro-vide inspiration […].	• Developing Sustainable Forestry Management indicators and criteria under FS will be streamlined with and support the achievement of NRL forestry targets: COM will identify additional indicators as well as thresholds or ranges for sustainable forest management concerning in particular forest ecosystem health, biodiversity and climate objectives. Subject to the impact assessment, these will be included in the future legislative proposal on EU forest planning and monitoring. • FS makes explicit reference to NRL.

[103] EU Soil Strategy for 2030 Reaping the benefits of healthy soils for people, food, nature and climate (17 November 2021) EUR-Lex - 52021DC0699 - EN - EUR-Lex (europa.eu)
[104] New EU Forest Strategy for 2030 (16 July 2021) EUR-Lex - 52021DC0572 - EN - EUR-Lex (europa.eu)

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
		Develops guidance on the different financing measures for forest protection, restoration […].”	
Action Plan to conserve fisheries resources and protect marine ecosystems	Incoming, 2022	• Provides an action plan to conserve fisheries resources and protect marine ecosystems, thereby reducing pressures on marine ecosystem/species degradation.	• NRL targets/monitoring and the action plan both contribute to reaching favourable conservation status and good environmental status of marine waters.
EU guidance documents			
Guidance on the prioritisation of species and habitats for restoration to improve status of at least 30 % of species and habitats currently not in FSC[105]	Existing (June 2021)	• The guidance provides clarification on the scope of the target and suggests criteria for MSs to prioritise habitats and species for which measures shall be put in place to improve their status, or at least achieve a strong positive trend, by 2030.	• There are strong synergies between the NRL and the so-called “30% status improvement target”, insofar as both aim at achieving, by 2030, significant improvements in the status of habitats and species protected under EU Nature legislation. De facto, most of the measures required to improve the status of species and habitats would quality as ecosystem restoration measures under the proposed NRL. • As achieving the (voluntary) 30% status improvement target by 2030 requires that Member States submit their pledges in 2022 and start implementing the necessary improvement measures as soon as possible thereafter, implementing the target might act as a “test-bed” or precursor for the legally binding and ecosystem-specific (and hence more constraining) targets under the NRL, the date of entry into force of which cannot yet be anticipated.
Criteria and guidance for protected areas designation[106]	Existing (January 2022)	• The guidance provides criteria for MSs to identify additional protected areas.	• There are synergies with the NRL as restored ecosystems under NRL outside Natura 2000 or other existing protected areas could be designated as (strictly) protected areas thus contributing to the relevant BDS2030 targets. Furthermore, protected areas and strictly protected areas may contribute to achieving the restoration targets under NRL.

[105] Guidance on the selection and prioritisation of species and habitats for priority actions to ensure that at least 30% of species and habitats not currently in favourable status are in that category by 2030, or at least show a strong positive trend, June 2021. link: https://circabc.europa.eu/ui/group/fcb355ee-7434-4448-a53d5dc5d1dac678/library/4d8f2f91-7708-4ed2-ba0e-e7a945a6d56a/details

[106] SWD(2022) 23 final

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
Technical guidance and support to MS to identify sites and help mobilise funding for the restoration of 25,000 km of free flowing rivers[107]	Existing (December 2021)	• Aims to support the identification of restoration sites and of funding opportunities to achieve the BDS2030 target of restoring 25 000 km of rivers into free-flowing state.	• The guidance document is a stepping stone towards faster and more ambitious implementation of the WFD, in line with the BDS2030. • It is designed to provide clarification on the concept of free-flowing rivers and to contribute to a common understanding of how this target is linked to the objectives of the WFD and of EU Nature Directives. • The guidance will support MS in devising measures to achieve a potential NRL target related to the restoration of rivers into free-flowing state.
Technical guidance on urban greening	Incoming (Q1 2022)	• In the BDS2030 the Commission 'called upon' all cities of over 20 000 inhabitants to develop Urban Greening Plans – this technical guidance will explain what and how this process can be implemented. • The technical guidance will, in this way, help to set the framework from which local authorities can plan and implement actions to improve the quality of urban ecosystems by making Urban Greening Plans. • It will include suggestions for the governance of urban green planning (i.e. how to integrate it with other local planning processes and how to engage local actors in the process) and set a baseline of what indicators need to be mapped, measured and monitored to understand local ecosystems.	• To set and meet any targets – voluntary or legally based – relating to urban greening, the quality of urban ecosystems requires appropriate, systematic mapping and monitoring of certain key indicators at the local level. • The technical guidance will support this process fully. Any NRL targets for urban ecosystems will be mirrored in the technical guidance (and supported by the establishment of an urban greening platform).
Establishment of a new cooperation-based EU biodiversity governance (including a monitoring and	Incoming	• BDS2030 announced the setting up of a new cooperation-based EU biodiversity governance framework to steer the implementation of biodiversity commitments agreed at national, European and international level. This framework is under development and will be finalised in cooperation with the Member States and stakeholders. It will include a system of expert groups for the coordinated implementation of the Strategy, a monitoring and review mechanism to enable regular	• The governance structure for the implementation of the future EU Nature Restoration Law will be integrated into the wider biodiversity governance framework. This may include: o new expert groups, Committees, scientific or stakeholder bodies to be set up for the implementation of the new legislation, o certain aspects of the NRL implementation to be reflected in the mandate of existing groups and bodies as appropriate (e.g. on

[107] Guidance on Barrier Removal for River Restoration (europa.eu), 21 December 2021

Policy initiatives and laws	Status	Relevance for ecosystem restoration	Possible alignment/overlap/synergies with the proposed Nature Restoration Law (NRL)
review mechanism)		progress assessment and corrective action if needed, as well as measures to support administrative capacity building, input from science, transparency, stakeholder dialogue and participatory governance at different levels.	soil, on forests and nature, on monitoring and assessment and others), o interaction with further groups to ensure synergies with other policy areas, o the integration of indicators and requirements set by the new NRL to monitor restoration progress and gather knowledge on ecosystem condition and services, into the wider biodiversity and environmental monitoring frameworks; and building on existing indicators to the extent possible, and o the streamlining of reporting processes and online tracking tools to minimise administrative burden.
Guidance on new sustainability criteria on forest biomass for energy, that have to be developed under the Renewable Energy Directive – 2021 (suggestion EASME)[108]	Incoming, 2021	• Provides guidance on sustainability criteria on forest biomass for energy, that will be developed under the Renewable Energy Directive (RED). • A draft RED and implementing act are currently under discussion with MS. The degree of emphasis on biodiversity, for example in the context of regeneration, is still to be decided on.	

[108] JRC Publications Repository - The use of woody biomass for energy production in the EU (europa.eu), 2020

3. Approach to non-deterioration

It is important to ensure that the condition of ecosystems in the EU does not deteriorate. This can apply to areas that need to be restored as well as those that are already in good condition and need to be maintained. Protecting areas that still need to be restored from further degradation means that less efforts/investments will be needed to restore them later, and protecting areas that are already restored means that the returns on such investments are maintained. A further argument for non-deterioration can be based on the potential of providing ecosystem services such as carbon sequestration or natural carbon storage, e.g. wetlands. These would naturally favour the non-deterioration of these territories. Overall, an approach needs to be developed in which restoration goes hand in hand with (long-term) protection and maintenance.

To address the issue of non-deterioration it is useful to consider areas of terrestrial territory according to the following three main regimes:

a. Annex I habitats of the HD and habitats of protected species and within N2000. It is estimated that 44 % of HD Annex I habitat area lies within Natura 2000. For these areas, the duty of non-deterioration is already covered by existing legislation.
b. Annex I habitats of the HD and habitats of protected species but outside N2000. 56 % of HD Annex I habitat area lies outside Natura 2000. For these areas, the duty of non-deterioration is partly covered by fault-based or negligence-based prevention and remediation duties under the Environmental Liability Directive, and sometimes by strict liability under this. It is also implicitly covered by the requirement of the Habitats Directive to maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of Community interest at national/biogeographical level. In addition, aquatic and riparian habitats within this category benefit from the non-deterioration and other requirements of the Water Framework Directive. The duty not to deteriorate also exists for breeding sites and resting places of protected species, but this is limited to those listed in Annex IV of the Habitats Directive. Relevant duties also exist for wild birds' habitats across the territory of the Member States. However, even taken together, there are shortcomings. ***Therefore, to ensure a comprehensive protection level, establishing additional duties under the nature restoration law to ensure non-deterioration would probably be needed.*** These could however, be lighter than those obligations to ensure non deterioration within Natura 2000.
c. Ecosystems beyond any protection (e.g. those not covered by Annex I habitats and not habitats of protected species). Ensuring no deterioration for habitats other than HD Annex I habitats and habitats of protected species is more challenging, although some results are achievable through , for instance, minimum standards for farmers benefitting of CAP support of Good Agricultural and Environmental Conditions (GAEC) under current cross-compliance. Resulsmay also be achievable in other ways; aquatic and riparian habitats within this category, for instance, benefit from the non-deterioration and other requirements of the Water Framework Directive. ***A process to set a further non-deterioration requirement*** (e.g. through

new duties as explained below) ***could be established together with the process for setting additional targets*** (e.g. through setting up a monitoring mechanism to measure ecosystem conditions and set baselines first). These targets and any requirements of non-deterioration could then be established in law in step 2.

The following points should also be taken into consideration:

- Habitats outside Annex I that are turned into an Annex I habitat types (through restoration / re-establishment) would then become part of Annex I and enjoy the same protection, either as in a) or b).
- The EIA and SEA Directives can help identify projects and plans likely to exacerbate ecosystem degradation and can be used to help avoid some degree of non-deterioration across a), b) and c).

A similar approach could be envisaged for marine territories. The Marine Strategy Framework Directive aims to achieve the broad goal of Good Environmental Status (GES) of the EU's marine waters. Further to that, Annex I marine habitats are protected within Natura 2000 marine sites, for instance, and enjoy a measure of protection outside them thanks to the ELD, the overarching objective of the Habitats Directive and other instruments.

Restored areas need to receive a type of protection that will ensure the full recovery of the restored areas and ensure the long-term viability of the restored ecosystem. These could for example be designated as protected areas and be taken into account for the 30 % protected area and 10 % strictly protected area targets. Member States may choose other means to ensure long-term protection of the restored areas, such as Other effective area-based conservation measures (OECM) or private land conservation measures. Where appropriate, in particular in the marine environment, Member States may choose to achieve the restoration targets by ensuring strict protection of the areas hosting the degraded ecosystems (passive restoration).

Annex XI: Restoration frameworks in Member States

Obtaining data on the area of ecosystems undergoing restoration in Europe is a challenge due to a number of factors, including the fact that much restoration activity is voluntary and that there are few legal mechanisms that require reporting of the areas restored[109]. The Netherlands, Germany, Belgium (Flanders), Austria and Spain have put in place Restoration Prioritisation Frameworks. Furthermore, in the first Expert Workshop towards an EU legal proposal for binding restoration targets organised by the Commission (9 December 2020), a number of Member States also shared information about national restoration efforts.

Member States that have submitted Ecosystem Restoration Prioritisation Frameworks (RPF) at national or sub-national level (Target 6A in the EU Biodiversity Strategy to 2020)[110]	
Netherlands	Naar een strategisch kader voor ecosysteemherstel ('RPF') in Nederland (Towards a strategic framework for ecosystem restoration in the Netherlands), 2014.
Germany	Priorisierungsrahmen zur Wiederherstellung verschlechterter Ökosysteme in Deutschland (Prioritisation framework for the restoration of degraded ecosystems in Germany), 2015.
Flanders (Belgium)	Prioriteitenkader voor ecosysteemherstel in Vlaanderen (Prioritisation framework for ecosystem restoration in Flanders), 2016.
Austria	Strategischer Rahmen für eine Priorisierung zur Wiederherstellung von Ökosystemen auf nationalem und subnationalem Niveau, 2020[111].
Spain	Spanish National Strategy for Green Infrastructure, Connectivity and Ecological Restoration, 2021.

Additional information on national restoration efforts shared by Member States in the first Expert Workshop towards an EU legal proposal for binding restoration targets organised by the Commission, 9 December 2020	
Sweden	• Prioritised Action Framework (PAF) for Natura2000 in Sweden • National environmental objectives • National species action programmes • Regional plans for Green Infrastructure • National programme of action for remediation of water courses • Municipal biodiversity programmes • Wetlands restoration project 2018 - ongoing. Promoting construction of new and restored wetlands all over Sweden

[109] Technical support in relation to the promotion of ecosystem restoration in the context of the EU biodiversity strategy to 2020, Final Report.

[110] SWD/2019/184 final.

[111] Publikationsdetail *Strategischer Rahmen für eine Priorisierung zur Wiederherstellung von Ökosystemen auf nationalem und subnationalem Niveau*, (umweltbundesamt.at).

	in order to strengthen the landscape's own ability to maintain and balance water flows
Ireland	Ireland’s Protected Raised Bog Restoration Programme
Finland	• Biodiversity strategy • Helmi programme • METSO programme • Ecosystem restoration and management monitoring for different habitat groups (forests, semi-natural grasslands, mires)
Portugal	2030 Biodiversity & Nature Conservation National Strategy - Resolution of the Portuguese Council of Ministers: Axis 1 - Improve natural heritage conservation status Axis 2 - Promote recognition of the natural heritage value Axis 3 - Encourage appropriation of natural values & biodiversity by the stakeholders. Biodiversity & Nature Conservation Action Plan Protected Areas Management Plans

Annex XII: Financing options at EU level

This annex provides an overview of the financing needs as well as potential sources of financing for ecosystem restoration at EU level, including programmes and funds under MFF 2021-2027, Next Generation EU as well as private investments. Member States would be asked to outline in their National Restoration Plans how they would access these sources. In addition, Member States would need to outline available funds from their national and local budgets as well as how market-based instruments are used to help cover the cost of ecosystem restoration and prevent deterioration.

The Biodiversity Strategy for 2030 states that biodiversity action requires at least EUR 20 billion per year stemming from "private and public funding at national and EU level", of which the EU budget will be a key enabler and component. As such, in December 2020 the EU co-legislators came to the **interinstitutional agreement**[112] to set a biodiversity spending target of 7.5 % as of 2024 and 10 % as of 2026 under the 2021-27 MFF. Mainstreaming and tracking of biodiversity in EU programmes and funds are currently being revised to strengthen biodiversity considerations and fill the financing gap that is, according to draft Programme Statements in March 2021, foreseen to be at least €1.924 billion for 2026 and €2.291 billion for 2027.

Specifically, the European Agricultural Fund for Rural Development (EAFRD) and European Agricultural Guarantee Fund (EAGF) will be central to achieving higher levels of biodiversity spending under the 2021-27 MFF. Furthermore, Cohesion policy funds and the European Maritime Fisheries and Aquaculture Fund (EMFAF) will also play a central role in achieving the biodiversity ambition. Other programmes will also contribute to this target, such as LIFE, Copernicus and InvestEU. Member States would also be encouraged to seek synergies between different programmes and funds to support large-scale implementation of restoration projects.

Moreover, the Biodiversity Strategy for 2030 states that a significant proportion of the part of the 2021-27 MFF dedicated to climate action will be invested in biodiversity and nature-based solutions. As ecosystem restoration will directly contribute to climate mitigation and adaptation objectives, restoration would also benefit from the climate spending target in the MFF.

Financing needs for ecosystem restoration under policy options 3 and 4

Restoration costs

According to the two scenarios with different ambition levels (15-40-100 % restoration versus 30-60-100 % restoration, both for 2030-2040-2050) presented in the table below based on a more detailed table in Annex VI, the average annual restoration, re-creation and maintenance costs to 2030 for **peatlands, marshlands, forests, heathland and scrub,**

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[112] Regulation (EU, Euratom) 2020/2092.

grasslands, rivers, lakes and alluvial habitats, and coastal wetlands are estimated at EUR 5.3 billion for Scenario A and EUR 7.6 billion for Scenario B.

Ecosystem type	Scenario A: 15 % by 2030, 40 % by 2040, 100 % by 2050		Scenario B: 30 % by 2030, 60 % by 2040, 100 % by 2050	
	Average annual cost to 2030 (€M)	Average annual cost to 2050 (€M)	Average annual cost to 2030 (€M)	Average annual cost to 2050 (€M)
Peatlands	202	265	274	266
Marshlands	165	175	173	177
Coastal Wetlands	195	331	352	331
Forests	2097	2811	2916	2816
Agro-Ecosystems	1221	1353	1367	1353
Heathland and scrub	139	148	148	149
Rivers, lakes and alluvial habitats	1299	2282	2407	2279
Total	5318	7365	7637	7371

Note: opportunity costs in terms of foregone income (e.g. by landowners as a result of rewetting a grassland so that it becomes a wetland) are included in the calculation of restoration and maintenance costs. Opportunity costs of potential land use changes (e.g. turning grassland into an industrial district) are not included.

For **Natura 2000 sites**, estimates of restoration costs until 2030 are also available under the MS Prioritised Action Frameworks (PAFs) submitted in March 2021: a total cost for one-off maintenance and restoration projects sites for a number of ecosystem types amount to approximately EUR 10 billion over 2021-27 (1.4 billion annually). It should be noted that these figures focus on Natura 2000 i.e. do not address the broader ecosystem restoration funding needs including beyond the N2000 network.

PAF figures on restoration based on aggregated estimations by Member States	
A: Natura 2000 site-related maintenance and restoration measures for species and habitats	***One-off/ project costs (MEUR/year)***
Marine and coastal waters	103
Heathlands and shrubs	79
Bogs, mires, fens and other wetlands	201
Grasslands	334
Other agroecosystems (incl. croplands)	89
Woodlands and forests	352
Freshwater habitats (rivers and lakes)	272
Total annual costs	***1 430***
Total (2021-2027)	***10 010***

Note: Opportunity costs such as income foregone are included in the figures for Member States that are planning to compensate landowners for restoration.

The annual cost figure, for example of EUR 7.6 billion under scenario B, is expected to be higher because restoration and maintenance costs for **marine**, **urban** and **soil ecosystems** as well as **pollinators** are not included due to uncertainties and data gaps on the restoration need and costs, although it is likely that pollinators will benefit from costs incurred to restore terrestrial ecosystems such as grasslands.

Costs for enabling measures (administrative costs)

Besides restoration and maintenance, there are costs foreseen for enabling measures such as establishing methodologies and indicators, developing National Restoration Plans and monitoring progress. According to the impact assessment study in Annex VI, these are estimated to include annual costs averaging EUR 583 million from 2022 to 2030 and EUR 498 million over the period 2022-2050..

Estimated costs for enabling measures (MEURO)		
	Average annual costs 2022-2030	***Average annual costs 2022-2050***
Surveys of ecosystems	122.1	37.9
Development of national restoration plans;	1.4	0.4
Development of methodologies and indicators (5 ecosystems)	0.7	0.2
Administration of restoration measures	438.3	438.3
Monitoring of restored ecosystems	20.6	20.6
Reporting progress against restoration targets	0.1	0.1
Total annual costs	***583.3***	***497.6***

Conclusion

While the cost estimates will need to be more precisely calculated, they do provide an indication of how much financing at least needs to be mobilised, namely between **EUR 5.9 billion and 8.0 billion over the period 2022-2030**. While these costs can be largely compensated by increased potential for ecosystem services, it should be noted that this estimate does not consider the restoration and maintenance costs for some ecosystems for which data is lacking. As such, the **total costs are expected to be higher**. Moreover, the precise costs for each Member State will vary in line with subsidiarity, as costs depend on the specific restoration needs, priorities, measures as well as land prices and wages per Member State.

Cost item	**Amount in EUR billion**
Restoration and maintenance costs for peatlands, marshlands, forests, heathland and scrub, grasslands, rivers, lakes and alluvial habitats, and coastal wetlands	5.3 – 7.4
Enabling measures	0.6
Sub-total	***15.9 – 8.0***

Restoration and maintenance costs for marine, urban and soil ecosystems as well as pollinators	Not exactly determined

EU programmes and funds under MFF 2021-27 and Next Generation EU

The table below provides an overview of how EU programmes and funds under MFF2021-2027 and Next Generation EU can contribute to biodiversity with a focus on ecosystem restoration in their specific policy areas. The information, including estimates of available funds for biodiversity wherever possible, is based on the 'Biodiversity Financing and Tracking: First Interim Report' (study commissioned by ENV to IEEP/Trinomics, 2021), guidance on river restoration that is currently being prepared as well as an ongoing exercise of DGs ENV and BUDG to estimate the contributions from MFF funds and programmes to biodiversity in order to reach the new MFF target of 7.5/10 % for biodiversity spending.

According to figures prepared by DGs BUDG and ENV, under the MFF 2014-2020, biodiversity spending amounted to EUR 85 billion, which was about 8 % of the EU budget. Under the MFF 2021-2027, **estimates for biodiversity spending are available for 8 funds/programmes, amounting to nearly EUR 100 billion** (EUR 99 123.3 million), an average of approximately EUR 14 billion annually, of which a portion can be employed to the benefit of ecosystem restoration, including restoration projects, capacity building, knowledge exchange, monitoring and transboundary cooperation. **This means that the EUR 14 billion annual biodiversity spending under the MFF could cover to a large extent the annual total costs of restoration of EUR 6-8 billion, complemented with other sources of funding mentioned below.** Under the current methodology to track biodiversity spending in the MFF, it is not possible to estimate how much funds are channelled to ecosystem restoration.

EU programmes and funds under MFF 2021-27 and Next Generation EU

Source	Preliminary estimates of funds available for biodiversity in 2021-2027 (MEUR)	How could this financing source be used for ecosystem restoration?	Explanation	Financing type (grants/ loans) + beneficiaries
European Agricultural Guarantee fund (EAGF) under the Common Agricultural Policy (CAP) – still under discussion	37 885.2	• Restoration projects for agro-ecosystems	• EAGF funds could be used by MS to finance restoration (soil, habitats and species) under the foreseen eco-schemes, if MS outline this in their national CAP strategic plans for the following specific objective for the period 2023-27: contribute to the protection of biodiversity, enhance ecosystem services and preserve habitats and landscapes • It is estimated that 14.8 % was counted as biodiversity expenditure under MFF 2016-2020.	• Grants • Beneficiaries: farmers
European Agricultural Fund for Rural Development (EAFRD) under the CAP – still under discussion	26 513.2	• Restoration projects for agro/ forest ecosystems • Capacity/knowledge building • Knowledge exchange • Cooperation	• EAFRD funds could be used for restoration, particularly under the following priorities of (1) restoring, preserving and enhancing ecosystems related to agriculture and forestry (for 2021-22); as well as under the specific objective (2) contributing to the protection of biodiversity, enhancing ecosystem services and preserving habitats and landscapes (for 2023-2027). • MS would need to incorporate restoration measures in national CAP strategic plans. • At least 30 % of funding for each RDP must be dedicated to measures relevant for the environment and climate change, much of which is channelled through grants and annual and multiannual payments to farmers who switch towards more environmentally friendly practices or make investments environmental related. • While the European Commission approves and monitors CAP SP decisions regarding implementation, such as the selection of projects and the granting of payments are handled by national and regional managing authorities. • It is estimated that 33% of the total EAFRD budget under MFF 2014-2020 benefitted biodiversity.	• Co-financing for EAFRD • Beneficiaries: farmers, foresters and other land owners

Source	Preliminary estimates of funds available for biodiversity in 2021-2027 (MEUR)	How could this financing source be used for ecosystem restoration?	Explanation	Financing type (grants/ loans) + beneficiaries
European Regional Development Fund (ERDF) Cohesion Fund (CF)	20 138.2	• Restoration projects • Capacity/knowledge building • Cooperation	• ERDF could finance restoration projects that support i.a. (1) innovation and research; and (2) the low-carbon economy. • ERDF: at least 30 % of ERDF resources shall be allocated to Policy Objective 2 ('A greener, low-carbon Europe') in each MS/category of regions, covering investments in i.a. biodiversity, green infrastructure and pollution reduction. Investments could include ecosystem approaches as well as preserving and protecting the environment. • ERDF Interreg could finance cooperation across borders to jointly tackle common challenges and find shared solutions in fields i.a. environment (e.g. restoration projects). For cross-border cooperation, transnational cooperation and outermost regions' cooperation, 60 % of EU resources in programmes shall be allocated to at least 3 policy objectives, including Policy Objective 2 which is compulsory. • CF supports Policy Objective 2, and may contribute to the thematic concentration requirement for the ERDF allocation. MS whose GNI per capita is less than 90 % of the EU average are eligible. • ERDF and CF could also finance technical assistance. • ERDF and CF are implemented under shared management. Each MS prepares at national level a Partnership Agreement, including strategy, need, complementarity with other EU instruments and priorities to be supported by the funds, that is then implemented through programmes.	• ERDF: grants/financial instruments; maximum co-financing rate from 40 % to 85 % depending on the category of regions. • ERDF Interreg: co-financing up to 80 % (85 % for outermost regions) • CF: co-financing up to 85 %. • Beneficiaries: MS, private sector organisations, universities, associations, NGOs, civil organisations, etc.
Neighbourhood, Development and International Cooperation Instrument - Global Europe (NDICI - Global Europe)	NDICI: 6 209.7 Interreg PA III: 438.5	• Transboundary restoration projects • Transboundary cooperation	• NDICI could facilitate cooperation, knowledge exchange and finance for the restoration of ecosystems that extend to non-EU countries, with benefits in return for the EU • The first pillar of NDICI (geographical, including climate and environmental objectives) has potential to contribute to restoration. An EU Delegation, in close consultation with	• Grant, Service Contracts, blending • Beneficiaries: third countries/regions bordering the EU

Source	Preliminary estimates of funds available for biodiversity in 2021-2027 (MEUR)	How could this financing source be used for ecosystem restoration?	Explanation	Financing type (grants/ loans) + beneficiaries
Interreg Pre-Accession Assistance (PA) III		• Transboundary knowledge exchange	EUMS (Team Europe Initiative) and the local Authorities, draft country MIPs (Multiannual Indicative Programmes). Restoration projects could be added once the MIPs are adopted, considering they remain flexible. • It is unlikely that the second pillar (thematic liked to SDGs and global challenges) would contribute to restoration, unless there is a clear global initiative. • The third pillar (rapid response) can contribute in case of an emerging opportunity or need in terms of nature restoration in a third country, to which the EU could take a strong policy stance to influence decisions. • Restoration could furthermore be stimulated under Regional Programmes managed by INTPA, e.g. to restore the Amazon Basin. • Technical Assistance and Information exchange (TAIEX) could also be relevant for knowledge exchange between COM, MS and a third country in the context of transboundary restoration (workshops, missions and study visits). • The budget line on Overseas Countries and Territories (OCT) could also be relevant for restoration. • Interreg PA III can also be relevant. The draft regulation states that actions under this Regulation should, whenever possible, mainstream environmental sustainability and climate change objectives across all sectors with particular attention to environmental protection and tackling cross-border pollution. While it does not mention restoration explicitly, it could support restoration projects of ecosystems that extend to non-EU countries (Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, Serbia, and Turkey), supporting cooperation between candidate countries, potential candidate countries and EU Member States, to contribute in their accession preparations.	

Source	Preliminary estimates of funds available for biodiversity in 2021-2027 (MEUR)	How could this financing source be used for ecosystem restoration?	Explanation	Financing type (grants/ loans) + beneficiaries
Horizon Europe	6 042.0	• Capacity/knowledge building	• Horizon's first strategic plan 2021-2024 sets out i.a. the following strategic orientation: Restoring Europe's ecosystems and biodiversity, and managing sustainably natural resources. • The priority area of 'societal challenges – supporting research that addresses major social, environmental and economic issues and challenges' could support research activities underpinning the deployment of restoration projects (e.g. scientific research on ecological processes, development of tools for mapping and assessment). • Cluster 6 (Food, Bioeconomy, Natural Resources, Agriculture and Environment) includes a number of research areas related to biodiversity and nature protection, where calls will be launched in 2021-2 under the first work programme that can build the foundation or a future legal instrument. Also there will be a specific biodiversity focuses partnership, which will be launched this year. • The priority area of 'excellent science – aiming to boost top level research in the EU' could help to strengthen the capacity, skills, infrastructure and basic science underpinning restoration research. • Beneficiaries can respond to calls for proposals/ tenders.	• Grants and procurement financing • Beneficiaries: typically consortia including universities, research institutes and businesses
European Space Programme: Copernicus	930.0	• Monitoring	• Drawing from satellite Earth Observation and in-situ (non-space) data, the service component of Copernicus could be used to help monitor indicators of ecosystem condition i.a. across the areas of land, marine, atmosphere and climate change. • It supports applications i.a. on environment protection, management of urban areas, regional and local planning, agriculture, forestry and fisheries.	• N.a. • Beneficiaries: MS
Programme for the Environment and Climate Action (LIFE)	(2021-22) 966.5	• Restoration projects • Capacity/knowledge building (e.g.	• LIFE could fund restoration projects, in particular those supporting the BHD, N2000, IAS Regulation, BDS2030 and Green Deal.	• Grants, blending, prizes.

Source	Preliminary estimates of funds available for biodiversity in 2021-2027 (MEUR)	How could this financing source be used for ecosystem restoration?	Explanation	Financing type (grants/ loans) + beneficiaries
		testing innovative solutions)	• LIFE also offers technical assistance. • Beneficiaries can submit restoration proposals. • The EU LIFE Programme has been the EU's top funder for the restoration projects in a study by UNEP-WCMC, FFI and ELP, funding 76 % of the projects and accounting for 48 % of all funding for restoration in Europe.	• Beneficiaries: Public and private sector bodies and civil society organisations
European Maritime Fisheries and Aquaculture Fund (EMFAF)		• Restoration projects (marine and rivers) • Capacity/knowledge building	• EMFAF could fund marine and inland (river) water restoration projects, both inside and outside N2000, in support of the priorities of i.a. (1) fostering sustainable fisheries and the conservation of marine biological resources; and (2) strengthening international ocean governance and enabling safe, secure, clean and sustainably managed seas and oceans. • Under shared management, EMFAF is managed jointly by COM and MS and is implemented through national programmes prepared by MS managing authorities, where they outline their choices for fulfilling the objectives of the fund and identify actions in line with their national strategy. Under direct management, beneficiaries can respond to calls for proposals, including by CINEA, based on work programmes set out annually by the Commission. • In addition, under direct management, the EMFAF will support voluntary contributions to international organisations and technical assistance.	• Co-financing • Beneficiaries: MS, who can finance project submissions to calls for proposals • Grants and tenders • Beneficiaries: Public and private sector bodies and civil society organisations
European Social Fund (ESF) +		• Capacity/knowledge building •	• ESF could indirectly contribute to restoration by co-financing projects to equip people with the skills to contribute to restoration projects. • It is unlikely that substantial amounts of funds will be made available for biodiversity, let alone restoration.	• Grants • Beneficiaries: MS
Just Transition Fund (JTF)		• Restoration projects (e.g. peatlands)	• The first pillars of the Just Transition Mechanism is a new Just Transition Fund of €17.5 bn (€7.5 bn from 2021-2027 MFF and	• Co-financing according to Cohesion policy rules

Source	Preliminary estimates of funds available for biodiversity in 2021-2027 (MEUR)	How could this financing source be used for ecosystem restoration?	Explanation	Financing type (grants/ loans) + beneficiaries
		• Capacity/knowledge building	10 bn from the EU Recovery Instrument) to support MS in their green transition. • JTF may support investments in land recovery action in eligible territories most affected by an economic transition to carbon neutrality by 2050. • MS need to develop territorial just transition plans including social, economic, and environmental challenges; development needs (incl. environmental rehabilitation); and objectives to be met by 2030. • JTM could provide technical assistance, e.g. on how to integrate restoration in transition projects. • MS may, on a voluntary basis, transfer to the JTF additional resources from their national allocations under the ERDF and ESF+. • The second pillar under JTM, a dedicated InvestEU scheme, will be addressed under the InvestEU item.	• Loans backed by EU guarantees • Beneficiaries: MS
European Solidarity Corps		• Restoration projects	• Organisations can apply for the European Solidarity Corps funding as a response to calls for proposals by COM to develop restoration projects in which young people (18-30) can participate once approved. • Young people can do volunteering (2 weeks to 1 year), usually abroad in the Programme or Neighbouring Countries. COM outlines volunteering opportunities. • Young people can prepare their own Solidarity Projects addressing local challenges such as restoration.	• Grants • Beneficiaries: young people, MS
InvestEU		• Restoration projects	• InvestEU, including a dedicated scheme linked to the Just Transition Mechanism, is expected to mobilise more than €372 billion of public and private investment through an EU budget guarantee of €26.2 billion that backs the investment of financial partners such as the European Investment Bank (EIB) Group and others.	• Co-finance through loans, guarantees, equity etc., backed by an EU guarantee • Beneficiaries: implementing partners with whom the Commission has concluded a guarantee agreement (e.g.

Source	Preliminary estimates of funds available for biodiversity in 2021-2027 (MEUR)	How could this financing source be used for ecosystem restoration?	Explanation	Financing type (grants/ loans) + beneficiaries
			• It could co-finance and attract private investments for either specific restoration projects or broader projects where restoration is a component. • See more information in the section on public-private investments.	EIB, EBRD, national promotional banks)
Technical Support Instrument (TSI)		• Capacity/knowledge building • Knowledge exchange	• TSI provides tailor-made technical expertise to EU Member States to design and implement reforms in the areas of i.a. climate action (but biodiversity qualifies as well), for example in the drafting of National Restoration Plans. • MS can once a year submit a request for strategic and legal advice, studies, training and expert visits on the ground.	• Grants (no co-financing needed) • Beneficiaries: MS
Recovery and Resilience Facility (RRF)		• Restoration projects	• RRF could finance restoration projects, or projects with a restoration component. All reforms and investments must be implemented by 2026. • The preamble of the RRF Regulation states that the Regulation should contribute to mainstreaming biodiversity action in Union policies, and that the instrument should also tackle broader environmental challenges within the Union, i.a. the protection of natural capital and preserving biodiversity. Article 18(4e) states that the RRPs should include a qualitative explanation of how measures contribute to the green transition, including biodiversity, and whether they account for an amount that represents at least 37% of the plan's total allocation, based on the climate tracking methodology present in Annex IV. In the climate tracking methodology, biodiversity-related Intervention Fields include 050 on "nature and biodiversity protection, natural heritage and resources, green and blue infrastructure" as well as 049 on the protection, restoration and sustainable use of Natura 2000 sites. • Based on the 22 adopted Recovery and Resilience Plans, the majority of Member States have shown a strong commitment to biodiversity. Relevant measures include reforms and	• Combination of loans and grants • Beneficiaries: MS

Source	Preliminary estimates of funds available for biodiversity in 2021-2027 (MEUR)	How could this financing source be used for ecosystem restoration?	Explanation	Financing type (grants/ loans) + beneficiaries
			investments dedicated to restoring degraded ecosystems; implementing sustainable forest management and protecting habitats and species; improving forests' health and resilience; strengthening the knowledge of natural environment, such as biodiversity monitoring and setting conservation objectives and Natura 2000 management plans. Climate adaptation measures are also included in the plans, and can contribute to biodiversity objectives (e.g. when integrating nature based solutions).	

Private investments

Recognising that public grants cannot cover all the finance needed to reverse biodiversity loss and to have all EU ecosystems restored by 2050, there is a critical role for private sector grants as well as public and private commercial funding (including green equity and debt or bonds).

Private and/or commercial finance and investment solutions are increasingly considered as an option, as attention for the interrelation between nature, the economy and finance grew significantly over the last years. **WEF**[113] stated (2021) that over half of global GDP depends on nature and the services it provides. The **Independent 'Dasgupta' Review on the Economics of Biodiversity**[114] (2021) offers another recent case in point, by underlining that our economies, livelihoods and well-being highly depend on nature. The study '**Indebted to Nature: Exploring biodiversity risks for the Dutch financial sector**'[115] (2020) furthermore demonstrates that the financial sector–through investments in economic activities that depend on ecosystem services–is exposed to considerable material risk as a result of biodiversity loss. This makes the case for investing in nature and biodiversity for risk mitigation and economic resilience purposes. The **Task Force on Nature-related Financial Disclosures (TNFD)**[116] is currently developing a framework for financial institutions and corporates to identify and report on nature-related risks and dependencies.

At the same time awareness is growing that opportunities to invest in nature are huge. According to the **World Economic Forum**[117], action for nature-positive transitions at the global level could generate up to US$ 10.1 trillion in annual business value and create 395 million jobs by 2030. Through the **Finance for Biodiversity Pledge**[118], a number of financial institutions have committed to share knowledge, engage with companies, assess impacts on biodiversity, set targets and report publicly with the ultimate goal to reverse biodiversity loss in this decade.

An upcoming field is financing nature-based solutions (NBS) through multiple-benefit business cases where revenue streams come from co-benefits in terms of climate adaptation, health and carbon. The Impact Assessment study by the contractor provides insight in the co-benefits arising from services provided by specific ecosystems (e.g. peatlands offering much potential for carbon storage and sequestration), thereby helping to identify possible revenue streams for restoration.

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[113] New Nature Economy Report.
[114] Final Report - The Economics of Biodiversity: The Dasgupta Review.
[115] https://www.dnb.nl/en/actueel/dnb/dnbulletin-2020/indebted-to-nature/.
[116] https://tnfd.info/.
[117] World Economic Forum, *New Nature Economy Report II: The Future of Nature and Business*, 14 July 2020.
[118] https://www.financeforbiodiversity.org/about-the-pledge/.

There is also growing attention for the interrelation between nature, the economy and finance at EU level. The **EU Business @ Biodiversity Platform**[119], for example, provides a forum for dialogue and policy interface to discuss the links between business and biodiversity at EU level. It was set up by the European Commission with the aim to work with and help businesses integrate natural capital and biodiversity considerations into business practices. Other initiatives at EU level such as the upcoming Renewed Sustainable Finance Strategy, Green Bond Standard, EU Taxonomy and Non-financial Reporting Directive also contribute to ensure that the financial system supports the transition towards a sustainable economic recovery.

There are multiple examples of schemes and partnerships that aim at channeling private investments towards biodiversity objectives, such as the **Nature+ Accelerator Fund**[120], **Rewilding Europe**[121], **Commonland**[122], **Naturvation**[123], **CDC Biodiversité's offset banking**[124] and the **Coalition for Private Investment in Conservation**[125].

UNEP-WCMC, FFI and ELP (2020) studied the **funding of ecosystem restoration in Europe**[126], and found the following:

- Between 2010 and 2020, more than EUR 1.2 billion has been committed to over 400 projects, restoring over 11 million hectares of degraded ecosystems across Europe.
- To enable this, more than 200 funders from international bodies (most notably the European Commission), European governments, foundations and the private sector committed more than EUR 847 million in primary funding, with a further EUR 360 million committed as co-funding.
- Over 85 % of the restoration projects focused on terrestrial ecosystems, totalling over EUR 1 billion in project funding, with the majority of projects focusing on terrestrial forests, grasslands and wetlands.
- Over EUR 138 million has been committed to restoring European seas, focusing primarily on coastal marine ecosystems.
- Biodiversity conservation was the focus for 8 out of 10 projects and received nearly 80 % of the known funding. The aims of the remaining projects predominantly reflect climate change-related ambitions, such as mitigation and adaptation.

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[119] https://ec.europa.eu/environment/biodiversity/business/index_en.htm

[120] *Nature + Accelerator Fund*. An innovative and scalable market strategy for Nature-based Solutions.

[121] https://rewildingeurope.com/.

[122] https://www.commonland.com/.

[123] https://naturvation.eu/.

[124] https://www.cdc-biodiversite.fr/la-compensation-ecologique/recourir-a-un-site-naturel-de-compensation/.

[125] http://cpicfinance.com/.

[126] UNEP-WCMC, FFI and ELP, A summary of trends and recommendations to inform practitioners, policymakers and funders, 2020.

Whilst the needs and opportunities are clearly on the rise, the overall finance and investment landscape for nature and biodiversity finance and investment remains scattered and overall insufficient to counter negative trends.

The Commission will therefore consolidate and intensify its efforts to mobilise public and private funds and partnerships in support of the objectives set out in the EU Biodiversity Strategy for 2030 and related initiatives such as the **Commission Communication on Repair and Prepare for the Next Generation**[127]. In line with those strategic orientations, efforts are under way to establish a dedicated 'EUR 10 billion natural-capital and circular economy investment initiative' building on InvestEU and taking into consideration lessons learned from other public private funds such as the **Natural Capital Financing Facility**[128] and the **Global Energy Efficiency and Renewable Energy Fund**[129] operated by the EIB Group in cooperation with other public and private investment teams. It will make use of the EUR 9.8 billion guarantee for the Sustainable Infrastructure window (of which 60 % is earmarked for climate and environment targets), EUR 6.5 billion under the Research, Innovation and Digitalization window as well as EUR 6.9 billion under the Small and Medium Businesses window. On top of this, other EU programmes and funds will be tapped from as well as philanthropic institutions would be welcomed to contribute as well with the aim to unlock even more private funds. Note that this initiative under InvestEU is only a small part of the portfolios of EIB Group and other implementing partners, which means that there are potentially many more funds to tap from.

The availability of a pipeline of viable investment proposals (project and corporate investments) will be a critical factor for success. Based on lessons learned from the past, a significant effort is required to ensure the supply of adequate and multi-disciplinary technical assistance. A EUR 50 million green advisory initiative is therefore being established, funded from the LIFE programme. Funds will be used to top-up the InvestEU Advisory Hub that provides advisory services to public and private project promoters, as well as supporting financial and other intermediaries that take care of the implementation of financing and investment operations. Such advisory support includes three components: (1) project advisory for project identification, preparation, financial structuring, establishment of investment platforms and blending facilities; (2) capacity building for strengthening investment readiness and capacity of organisations, environmental and social sustainability impact assessments, procurement and compatibility with state aid rules; and (3) market development for preparatory activities in the form of studies, market assessment for policy development, communication and awareness raising. The LIFE sponsored contribution will be used i.e. to establish and co-finance a roster of green investment experts and other means to promote the development of natural capital

[127] Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committe and the Committee of the Regions Europe's Moment: Repair and Prepare for the Next Generation, COM/2020/456 final.
[128] Natural Capital Financing Facility. Boosting investment for biodiversity and nature-based adaptation to climate.
[129] https://www.eib.org/en/products/equity/funds/geeref

assessments that can help identify green investment opportunities for companies, sectors, and regions in the EU (possibly to be extended internationally).

To further encourage and support the mainstreaming of biodiversity among businesses and financial institutions, there is a considerable amount of information and tools available, such as the EIB's step-by-step guide to invest in nature, B@B's report **'Positive Impact Finance for Business & Biodiversity: Opportunities and challenges on scaling projects and innovations for biodiversity by the financial sector'**[130] and SBTN's **'Science-based Targets for Nature: Initial Guidance for Business'**[131].

All should allow to untap the significant potential for investing in nature restoration, including from private and commercial actors. Success will nevertheless require persistence over time; realistically, it can easily take five years or more to develop a significant pipeline of economically viable projects. The setting of a first batch of legally binding targets for nature restoration across the EU will greatly encourage public and private actors to join efforts in designing and funding viable nature restoration assets and activities that will enhance the resilience of our economies and people depending on it.

Conclusion

While the cost estimates will need to be more precisely calculated, it does provide an indication of how much funding at least needs to be mobilised, namely about **EUR 6-8 billion annually** until 2030, excluding restoration and maintenance costs for marine, urban and soil ecosystems as well as pollinators. So, the total cost is expected to be higher than this figure.

To reach this amount, a range of sources can be harnessed: First, under the **MFF to 2027** 100 billion will be available for biodiversity spending, which is equivalent to **EUR 14 billion annually**, of which a percentage could be used for restoration. Similar amounts could potentially become available under subsequent MFFs, especially if the biodiversity spending target of 10 % is extended.

Second, the **'EUR 10 billion natural-capital and circular economy investment initiative'** could be used, which is to be partially financed by InvestEU's sustainable infrastructure window of EUR 9.8 billion, of which 60 % is earmarked for climate and environmental targets. Parts of the guarantees under this facility could be employed as well as mobilise additional funds from private sources. The Research, Innovation and Digitalization window (EUR 6.5 billion) and Small and Medium Businesses window (EUR 6.9 billion) could also be tapped into, in addition to other funds from EIB Group and

[130] https://ec.europa.eu/environment/biodiversity/business/assets/pdf/Positive_Impact_Finance-EU_Business_Biodiversity_Platform_2018.pdf

[131] https://sciencebasedtargetsnetwork.org/wp-content/uploads/2020/11/Science-Based-Targets-for-Nature-Initial-Guidance-for-Business.pdf

other implementing partners. To do so coherently, MS could stimulate and/or partner up with private entities to submit project proposals that benefit restoration.

Third, **market-based instruments** could be promoted to help cover costs of restoration and to prevent deterioration, for example fiscal approaches, payments for ecosystem services, result-based payment schemes, etc.

Lastly, **national budgets** could cover any outstanding costs. The revised *Guidelines on State aid for environmental protection and energy (CEEAG)*[132] and the revision of *Commission Regulation (EU) No 651/2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty (block exemption Regulation)*[133] will allow Member States to grant state aid based on the investment costs for restoration, decontamination and biodiversity improvement works including protection/maintenance. Specifically, the guidelines state that investments may qualify if they lead to i.a. (a) the remediation of environmental damage; (b) the rehabilitation of natural habitats and ecosystems; (c) the protection or restoration of biodiversity and (d) the implementation of nature-based solutions for climate change adaptation and mitigation. If an investment does not fulfil the criteria for falling under the block exemption Regulation, the State aid would have to be notified to the Commission and analysed further before it could be approved. The aid may cover 100 % of the eligible costs minus the increase in the value of the land. The limit for funding individual restoration projects without notification is EUR 20 million per project. Above this amount, Member States will need to notify the investment to the Commission. State aid, however, cannot be granted to cover forgone income of economic operators, as the amount of the aid is calculated on the basis of the costs of the restoration project. Something else to keep in mind is that if the land or marine area is not used to conduct economic activities, support for its restoration projects would in principle fall outside the framework for state aid, as the notion of aid applies to support that benefits an economic activity.

In sum, while these figures provide order of magnitude estimates only, it supports the idea that there is a variety of sources of funding available to finance the costs for restoration, maintenance (including compensation) and enabling measures. In theory there is sufficient funding available, however, it depends on the priorities and actions of Member States and the EU whether these funds will be channeled towards ecosystem restoration. It can be expected that a legally binding instrument will contribute to this significantly.

[132] Communication from the Commission – Guidelines on State aid for climate, environmental protection and energy 2022, C/2022/481.

[133] https://ec.europa.eu/competition-policy/state-aid/legislation/regulations_en

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PART 3/12

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the

proposal for a Regulation of the European Parliament and of the Council

on nature restoration

{COM(2022) 304 final} - {SEC(2022) 256 final} - {SWD(2022) 168 final}

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ANNEX II: Stakeholder Consultation Synopsis Report

1. INTRODUCTION AND OVERVIEW OF THE CONSULTATIONS CARRIED OUT

The **scope** of the consultation activities, as outlined in the Consultation Strategy for this impact assessment, related closely to the initiative's policy objective to restore degraded ecosystems in the EU. The **objective** of the stakeholder consultations was twofold, namely to:

- Gather views, experiences, evidence and data from a wide range of stakeholders, particularly on topics where available evidence was scarce, and
- Test and validate existing analysis and preliminary findings to ensure that the impact assessment is informed by stakeholders and responds to their needs.

The **main stakeholder groups** consulted (based on a preliminary mapping in the consultation strategy) were Member States' authorities in charge of biodiversity, environment and other relevant policy areas at the national and sub-national level; umbrella sector organisations, groups and stakeholders; non-governmental organisations; academia and research organisations as well as the general public. The online public consultation provided an opportunity for any interested stakeholders or citizens to contribute with views and information.

Information about consultations on this initiative was provided via the dedicated page on the Commission's **biodiversity website**[1] and the **DG ENV twitter account**[2]).

The main consultation activities were:

1. Publication of **Inception Impact Assessment**[3] (4 November – 2 December 2020);
2. An **online public consultation**[4] (12 January - 5 April 2021);
3. Five online stakeholder workshops in the period November 2020 to September 2021.

Input from the stakeholder consultations was used in the data triangulation for the impact assessment. The main results from the consultations are summarized below.

2. SUMMARY OF CONSULTATION RESULTS

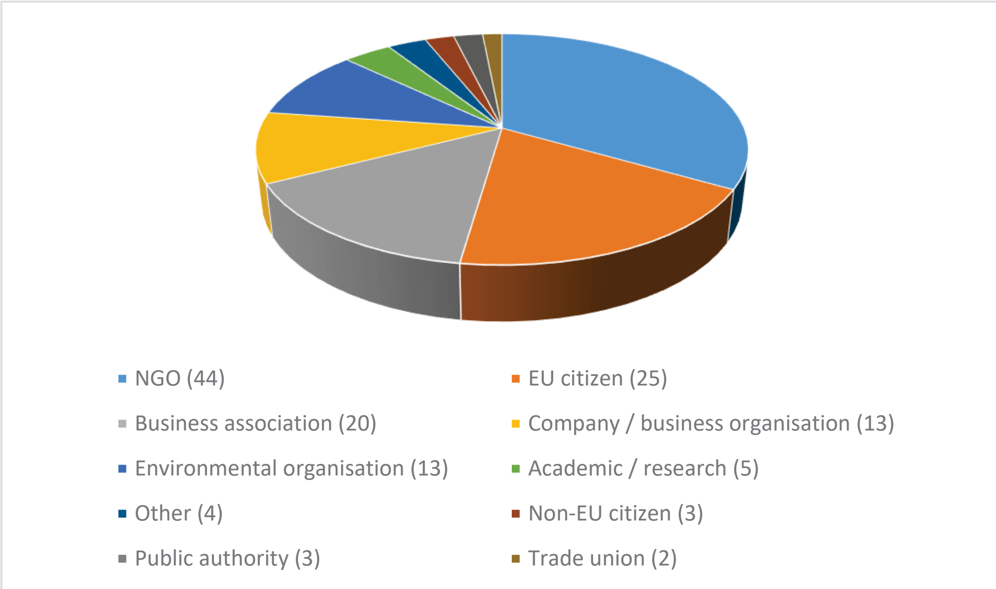
2.1. Inception Impact Assessment

An Inception Impact Assessment was open for public feedback from 4 November to 2 December 2020. A total of 132 responses were received, with the highest response rate from Belgium (24) and Germany (21), as well as fewer responses by stakeholders from most of the

[1] https://ec.europa.eu/environment/strategy/biodiversity-strategy-2030_en
[2] https://twitter.com/EU_ENV
[3] Protecting biodiversity: nature restoration targets under EU biodiversity strategy.
[4] See footnote 3.

EU Member States, as well as several non-EU countries. The share of respondents by different stakeholder groups is presented in **Figure 1-1** below.

Figure 1-1 Main types of respondents to the Inception Impact Assessment



The feedback received revealed overall broad support for the initiative across NGOs, academia, business, citizens and other organisations. Responses suggested that it should contribute as much as possible to the restoration of protected habitats and species - but also that it should go further to restore ecosystems and species not covered by EU legislation and foster connectivity through ecological corridors and green infrastructure.

Calls were made both for legally binding restoration targets and voluntary approaches (funding, payments for ecosystem services or compensation), as well as for measures to support community-led ecosystem restoration and management, knowledge, monitoring and research into the impacts of restoration. Passive restoration as well as measures to protect restored ecosystems and ensure their non-deterioration and sustainable management were considered essential.

Inputs included suggestions for overarching as well as ecosystem-specific EU targets, as well as examples of restoration actions. Some stakeholders proposed that binding targets should be set for the individual Member States, while most considered that the selection of restoration sites should be done at the national and sub-national level, and that the governance, monitoring and reporting framework should provide for this flexibility.

Organisations across the board stressed the need for policy coherence. While there was support for building synergies between biodiversity and climate objectives, many respondents pointed to trade-offs, whereas biodiversity should be priority for restoration.

Calls were made for a comprehensive impact assessment, stakeholder engagement and a science-based approach in the development of EU restoration targets.

2.2. Online public consultation

The survey on developing EU nature restoration targets was published as part of a joint online public consultation on three related biodiversity policy initiatives:

(i) Evaluation of the EU Biodiversity Strategy to 2020,

(ii) Review of the application of the EU Regulation on Invasive Alien Species, and

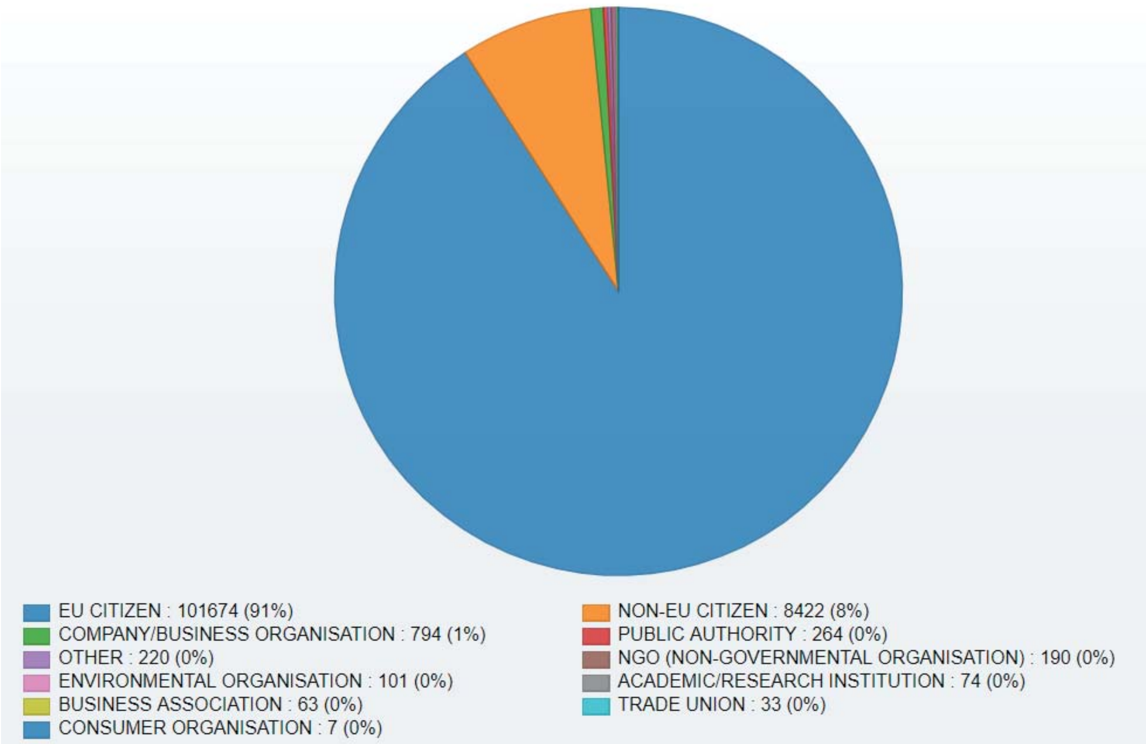
(iii) Development of binding EU nature restoration targets.

The aim was to avoid a proliferation of consultations and stakeholder fatigue, and to ask related questions together and once. The third part of the survey, related to this impact assessment, contained 8 main questions with multiple-choice answers, including an opt-out option ('Do not know'), boxes to elaborate in open text and an open question for further feedback or documents.

2.2.1. Respondent profile

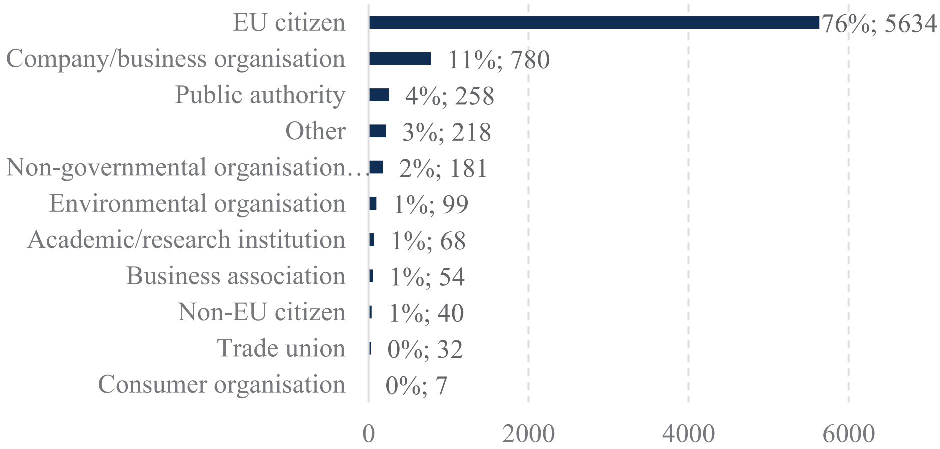
A total of 111 842 respondents filled in the questionnaire.

Figure 2-1 Main stakeholder types (all respondents)



A high number of the responses – 104 471 - were mobilised by the NGO-led campaign #RestoreNature. They provided identical responses, leaving question 1 unanswered. 99.6 % of these responses came from EU citizens or EU-based organisations. When this campaign was isolated, the main stakeholder types among the remaining 7 371 respondents changed as follows:

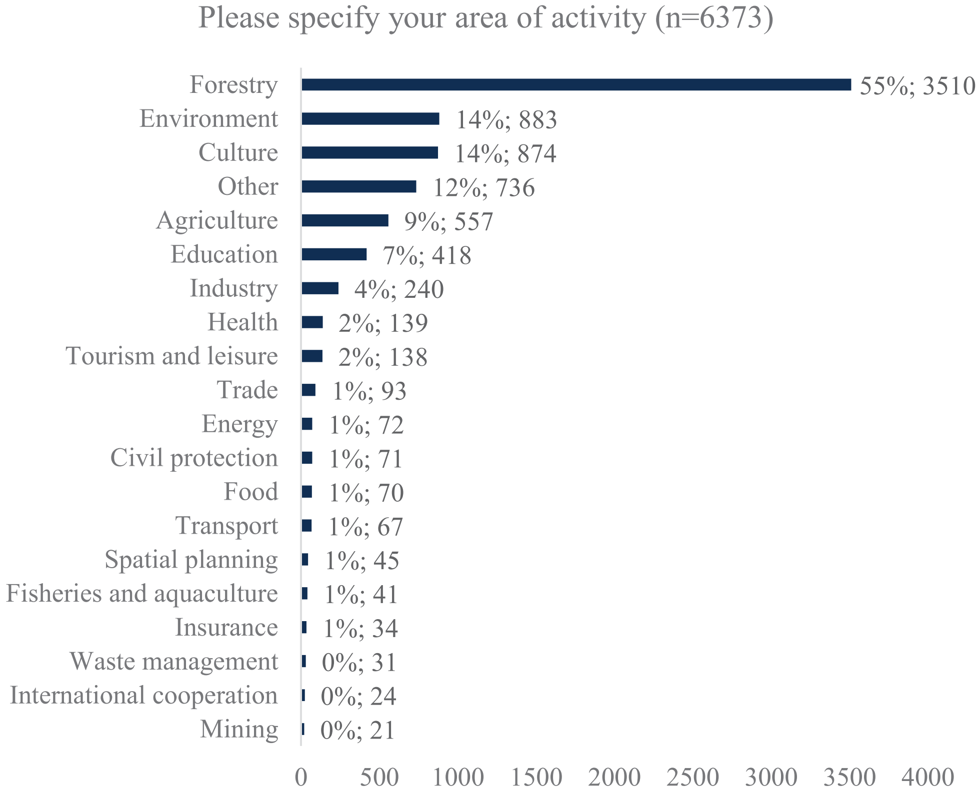
Figure 2-2 Main stakeholder types (without the #RestoreNature campaign)



Out of the 7 371 responses that were not part of the #RestoreNature campaign (the number of total responses to each question varied as not all respondents answered all questions):

- The overwhelming majority (90 %) came from Poland (6 621 responses). Only one response to the consultation per country was registered for 11 countries.
- Over half of the respondents who indicated their area of activity selected forestry (55 %), followed with a significant margin by environment (14 %), culture (14 %), agriculture (9 %), education (7 %) and industry (4 %). Forestry was the most represented area of activity for most stakeholder types, including 86 % of trade unions and 82 % of companies/businesses. The environment was most often indicated by NGOs and environmental organisations (51 %). Academic and research institutions indicated equally forestry and the environment (38 % each).

Figure 2-3 Area of activity of respondents (without #RestoreNature campaign)



- The most common stated stakeholder category was "EU citizen" making up just over three quarters of the respondents (5 634; 76 %), followed by companies/organisations (780; 11 %), public authorities (258; 4 %) and NGOs (181; 2 %). Other organisations represented less than 1 % of responses each. Among public authorities, 71 % were local, 16 % national, 10 % regional and 3 % international.

In summary, the #restorenature campaign mobilized 93,5 % of all survey responses. The overwhelming majority (90 %) of the remaining respondents originated from Poland; and 55 % specified forestry as their main field of activity. Analysis also revealed slightly different wording but similar meaning of qualitative answers provided by these respondents. A brief sub-analysis of responses is presented where such results have been significant.

2.2.2. Results

Quantitative information from the questionnaire responses was analysed using in-house tools of the support study contractor (Trinomics). The methodology is described in detail in the support study report. The sections below present for each question of the survey on the development of EU nature restoration targets:

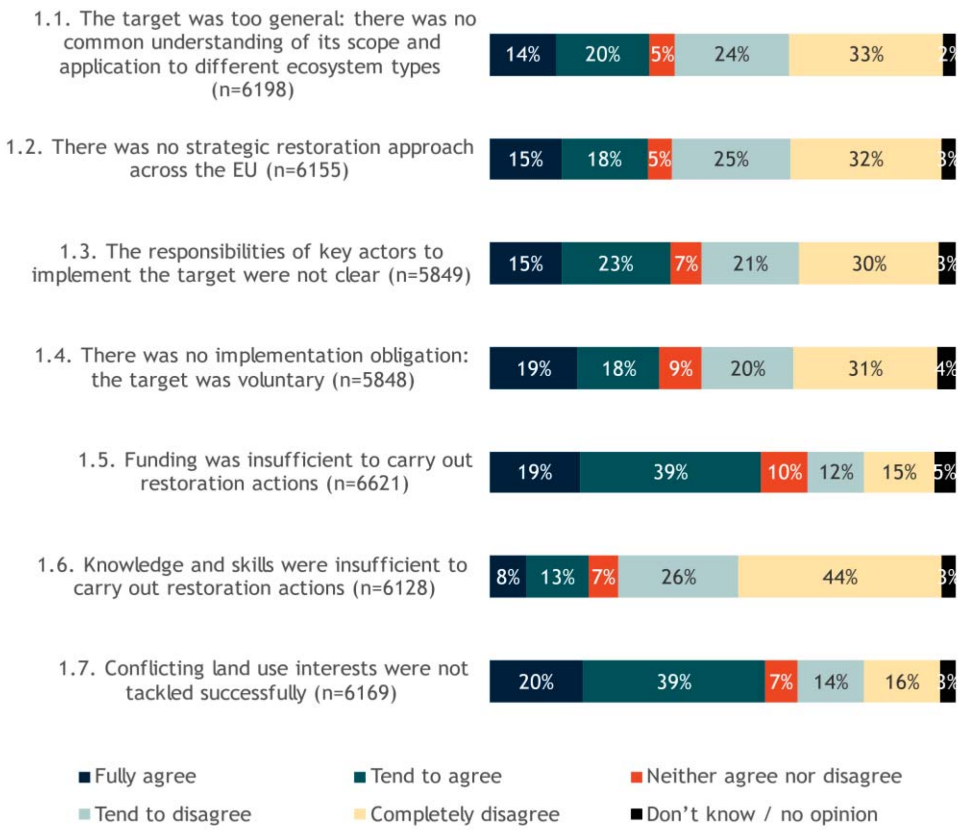
1) An overview of all quantitative responses;
2) An overview of the responses after isolating those mobilized via the #restorenature campaign, and a breakdown of key diverging responses per sectoral stakeholder type;
3) An overview of responses by Polish forestry stakeholders, where significant;

4) Qualitative inputs to open text survey questions (2, 3, 4, 5, 6, 7 and 8).

Question 1. *The EU Biodiversity Strategy to 2020 set the following target in 2011: "By 2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15 % of degraded ecosystems". While the evaluation of the strategy is ongoing, there is sufficient evidence that the 15 % restoration target has not been achieved. In your view, which of the factors below have undermined the delivery of the target?*

No responses were submitted for this question by the respondents associated with the #RestoreNature campaign. The quantitative responses are presented in Figure 2-4 below.

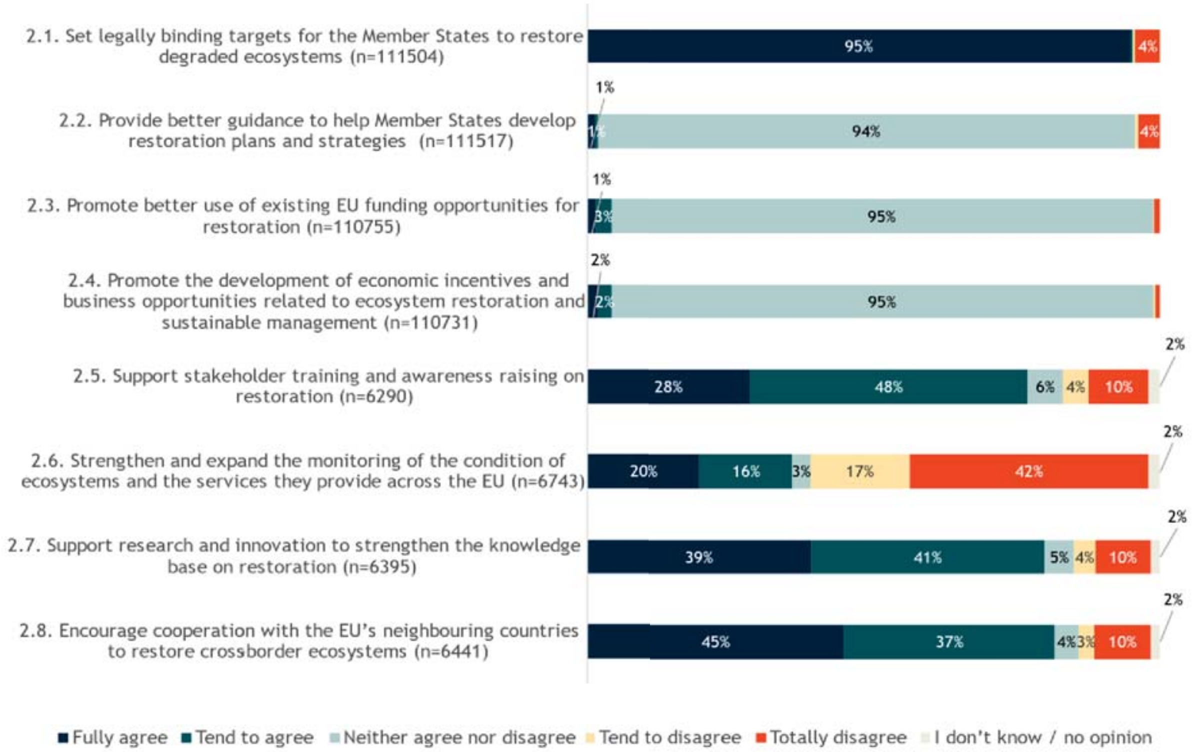
Figure 2-4 OPC responses to Question 1 (without #RestoreNature campaign)



The majority of stakeholders who 'completely disagreed' that the voluntary nature of the target had undermined its delivery were forestry-related (963; 54 %). The majority of stakeholders who 'fully agreed' or 'tended to agree' that unresolved conflicting land use interests were a factor belonged (in decreasing order) to the forestry, environment and culture sectors. The lowest number of respondents considered that insufficient knowledge and skills had been a barrier. Insufficient funding and conflicting land use interests were the answers most often selected by Polish forestry sector stakeholders (39 % and 41 % responded as 'tend to agree', respectively).

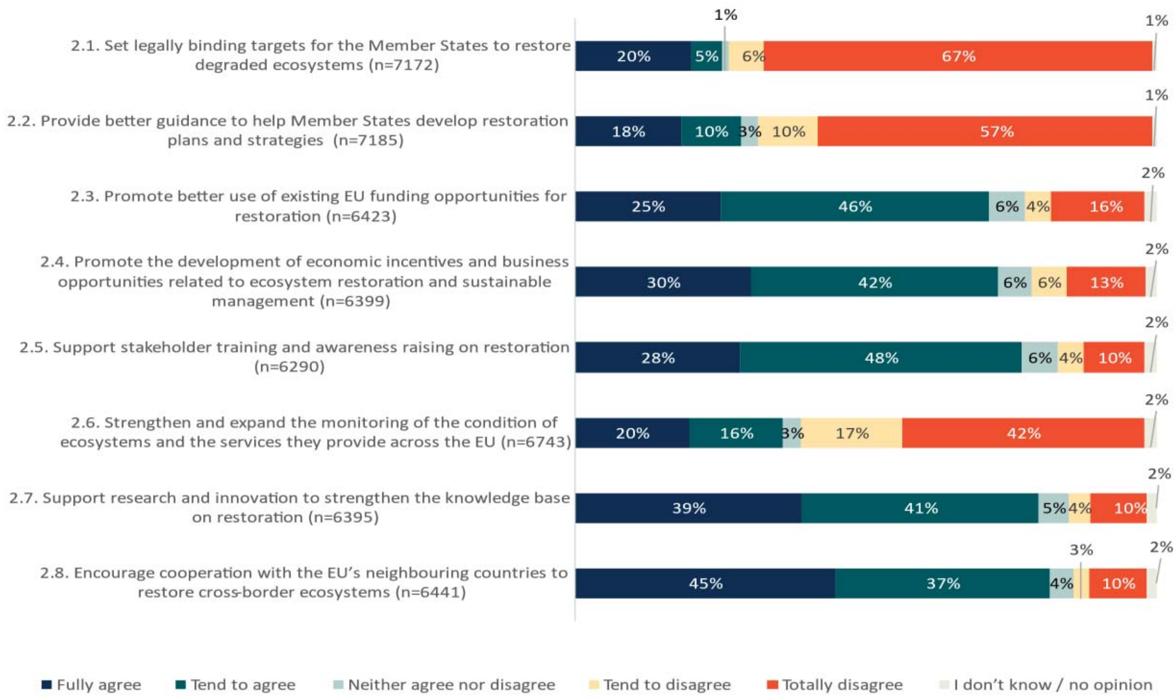
Question 2. *In order to step up the restoration of degraded ecosystems, the EU should:*
Figure 2-5 OPC responses to Question 2 (including NGO-led campaign responses)

Figure 2-6 OPC responses to Question 2 (all responses)



Campaign contributions dominated the response to options 2.1-2.4, resulting in 95 % of all respondents fully agreeing that the EU should set legally binding restoration targets.

Figure 2-6 OPC responses to Question 2 (without #RestoreNature campaign)

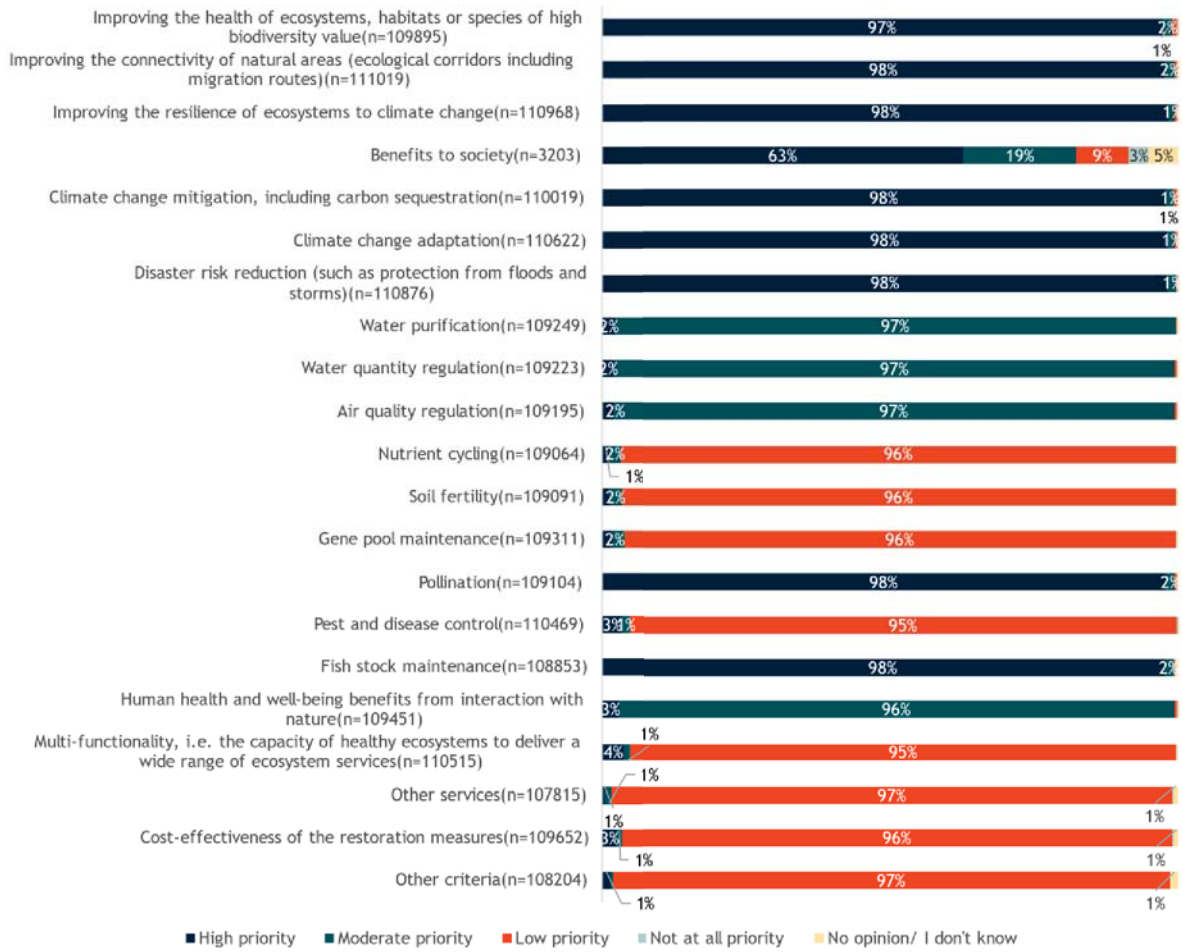


Once the campaign answers were excluded, the remaining respondents overwhelmingly rejected the setting of legally binding targets and the provision of guidance for Member States to develop restoration plans. Most respondents who 'totally disagreed' with these two options belong to the forestry sector (57 % and 55 % respectively), followed by culture and environment. These stakeholders gave more preference to soft measures: funding, economic incentives, training and awareness raising, research and innovation, as well as to cooperating with EU neighbours to restore cross-border ecosystems (forestry stakeholders gave the majority of positive responses to the latter).

Open text comments pointed to a lack of clarity on how restoration is defined, measured or evaluated, and called for a more uniform and clear definition ((9; 18 %) - all of which EU citizens, Poland) and for financial incentives to areas or countries for ecosystem restoration. Respondents also pointed to sustainable forestry management as a way to restore degraded ecosystems (9; 18 % - 8 EU citizens, 1 %).

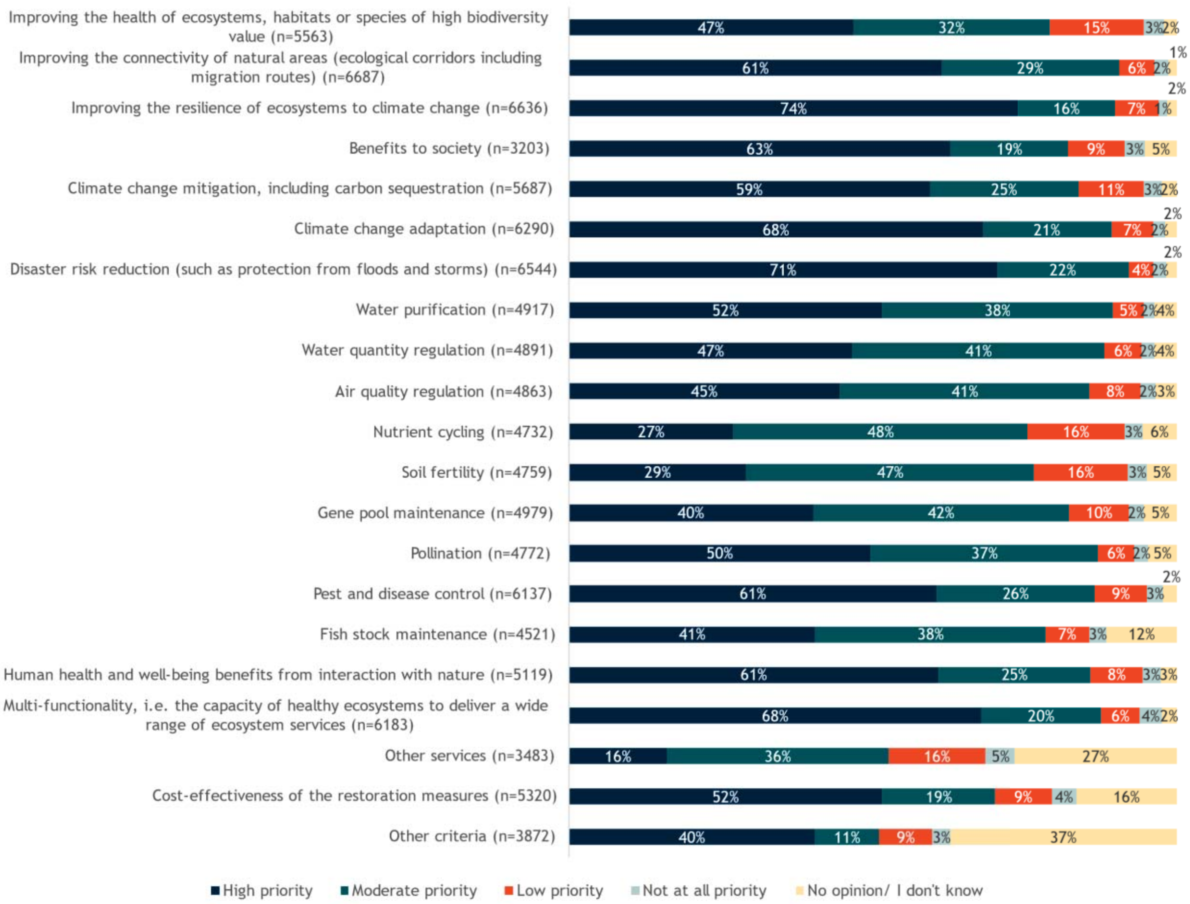
***Question 3**. To what extent should the following criteria guide the setting of priorities for restoration?*

Figure 2-7 OPC responses to Question 3 (all responses)



Campaign responses were given to every question except on 'benefits to society'. 'High priority' was given to improving the health of ecosystems, the connectivity of natural areas and the resilience of ecosystems, to climate change mitigation and adaptation, disaster risk reduction, pollination and fish stock maintenance. Moderate priority was given to water purification, water quantity regulation, air quality regulation and human health. Options on nutrient cycling; soil fertility; gene pool maintenance; pest and disease control; multi-functionality; cost-effectiveness; and other criteria were given 'low priority' in a significantly higher proportion than the answers to the same question without campaign responses, as highlighted in **Figure 2-8** below.

Figure 2-8 OPC responses to Question 3 (excluding responses submitted via the #restorenature campaign)



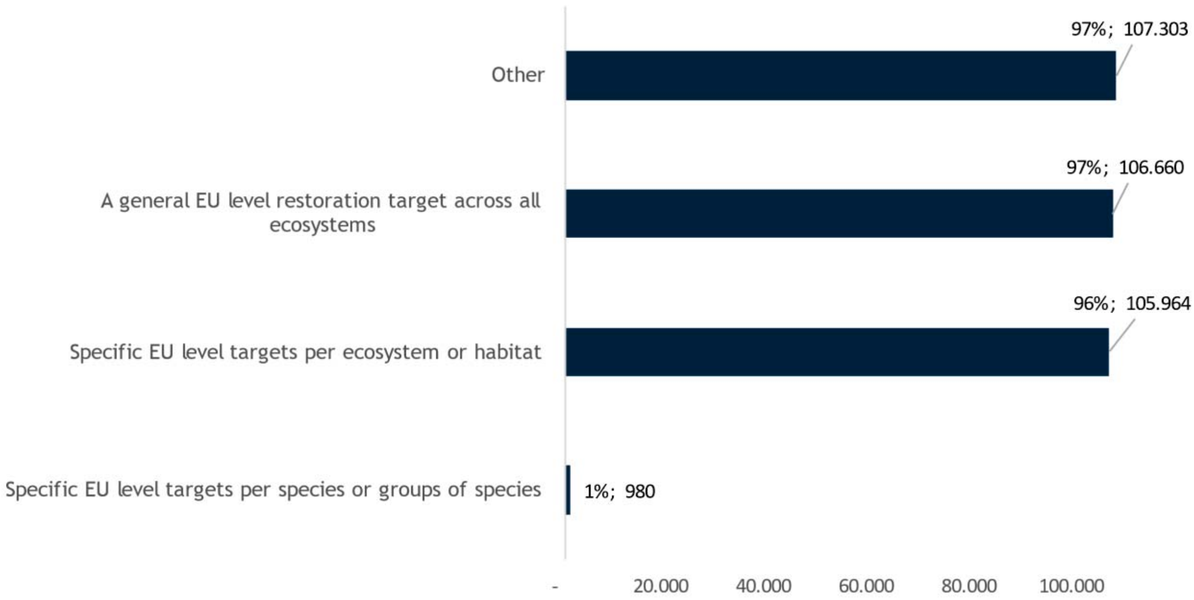
More than half of the respondents considered that all the criteria listed under question 3 should either moderately or strongly guide the setting of priorities for restoration. Improving the resilience of ecosystems to climate change and disaster risk reduction were the two criteria judged the most important (respectively by 74 % and 71 %). The least prioritized criteria were improving the health of ecosystems, habitats or species of high biodiversity value, nutrient cycling and soil fertility (with 19 % of respondents giving them low or no priority).

The results on ‘improving the health of ecosystems’ and ‘habitats or species of high biodiversity value’ showed particularly contrasting opinions within stakeholder groups: high priority for 34 % and low for 55 % of forestry actors; high priority for 18 % and low for 9 % of environment actors; and high-priority for 15 % and low for 12 % of culture actors. However, the majority of the responses that were not originating from Poland gave ‘high’ or ‘moderate’ priority to all listed but ‘cost effectiveness’.

Open-text responses suggested further criteria such as sustainable (forest) resource use and circular economy in forest products, the needs and role of local communities, local knowledge and culture and social and economic consideration for local communities.

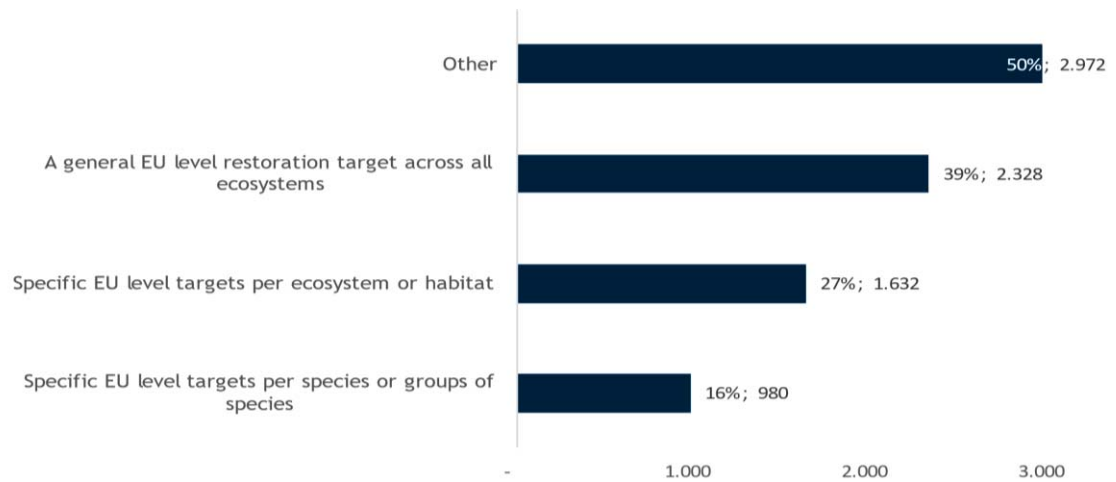
Question 4. *Restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Restoration targets may be set in a number of different ways. They can relate to incremental improvements of ecosystem condition or to reaching good condition; to a percentage of EU area or a specified extent of ecosystems on which restoration activities should take place. The restoration commitments of the EU Biodiversity Strategy for 2030 include such different approaches. In your view, should EU restoration targets be set as (multiple answers possible):*

Figure 2-9 OPC responses to Question 4 (all responses)



The #RestoreNature campaign did not include responses on EU level targets per species/groups of species. A significant proportion of responses were given to ‘other’ (see detail further down).

Figure 2-10 OPC responses to Question 4 (excluding responses submitted via the #RestoreNature campaign)



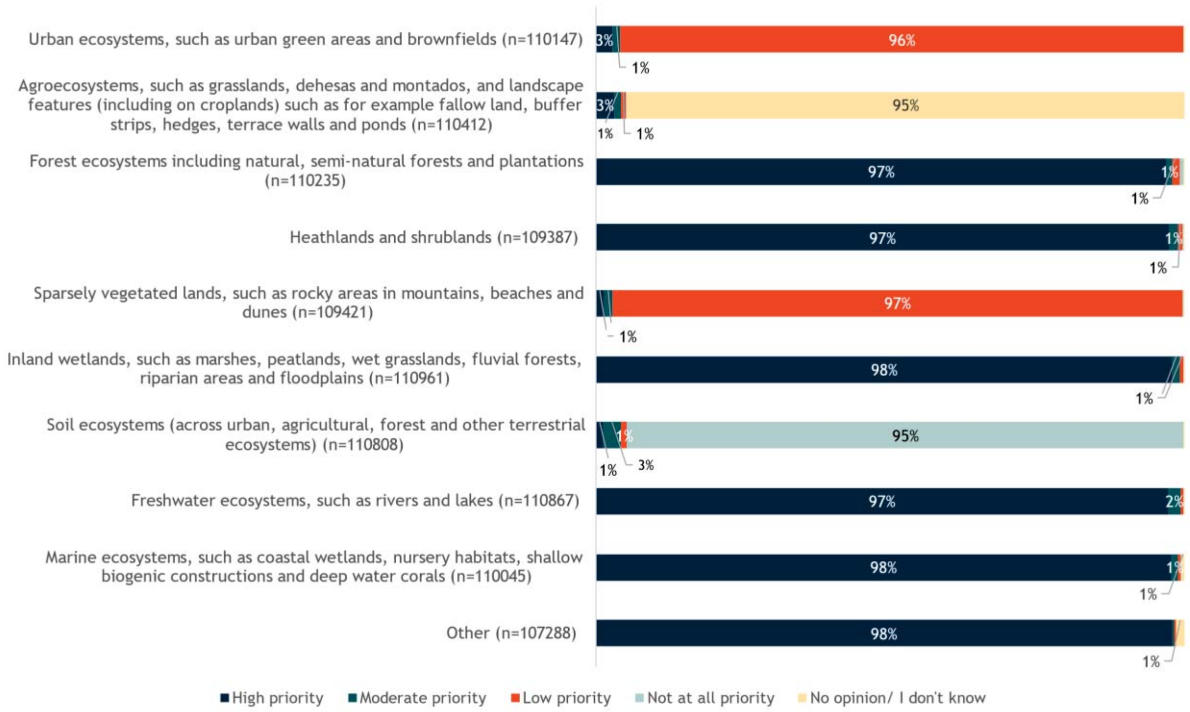
While the ranking of the options is clear, none was favoured by a majority of respondents. Forestry-related stakeholders rather favoured a general EU-level target across all ecosystems

(40 %) than specific EU targets per species or groups of species (29 %) or specific EU targets per ecosystem or habitat (22 %). Responses that originated from Poland largely favoured ‘other’ (53 %), followed by a general EU target (37 %).

Open text respondents overwhelmingly supported target-setting by the Member States (80 % of open text responses) pointing to local social, historical and cultural knowledge, differences in MS economy and policy structures and biodiversity and ecosystem differences within and between the Member States.

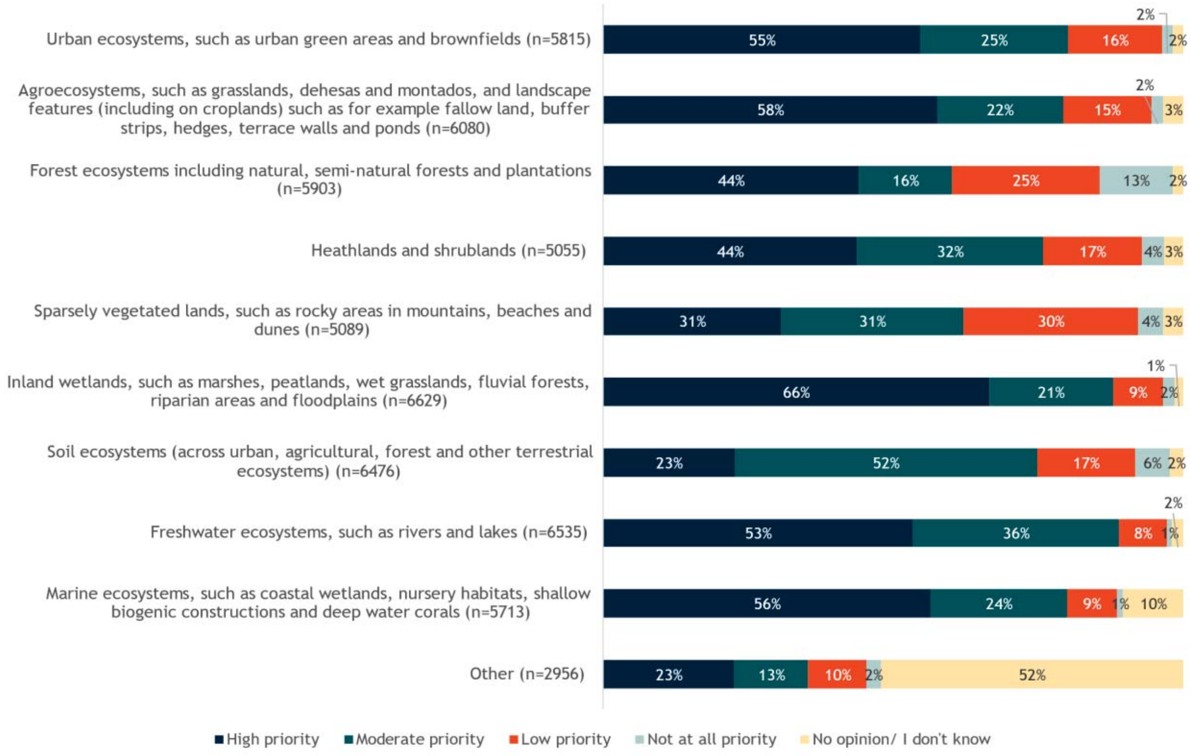
Question 5. *Should any of the following ecosystem types be prioritised for restoration in the EU?*

Figure 2-11 OPC responses to Question 5 (all responses)



Six ecosystems that received high percentage of ‘high priority’ responses: forests, heathlands, inland wetlands, freshwater, marine and other (elaborated separately). Conversely, urban ecosystems and sparsely vegetated ecosystems received predominantly ‘low priority’ responses. A high proportion of respondents stated that soil ecosystems should have ‘no priority at all’, and gave no opinion to agroecosystems.

Figure 2-12 OPC responses to Question 5 (without the #restorenature campaign)



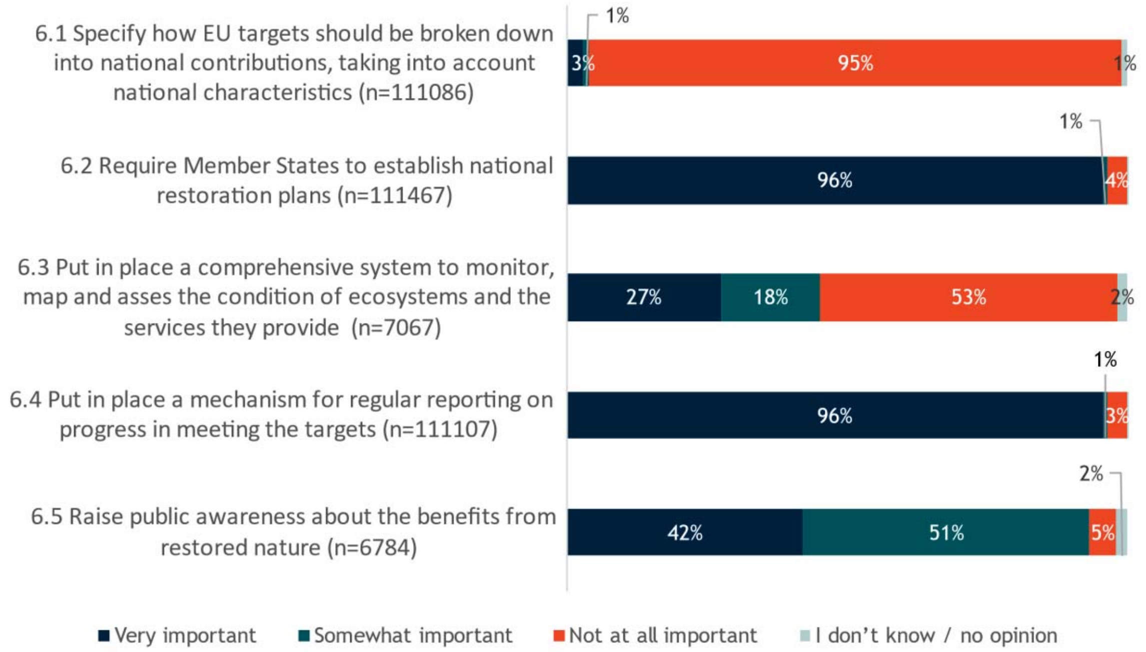
Five ecosystems were seen by more than half of respondents as high priority: inland wetlands, agroecosystems, marine, urban and freshwater ecosystems. All listed ecosystems were seen at least as a moderate priority by at least half of the respondents. Forest ecosystems were considered no priority at all by 13 % of respondents (13 %). Almost half of Polish respondents believed forestry ecosystems should be highly prioritised, indicating diverging opinions in this Member State.

Stakeholders indicating forestry background gave very similar numbers of responses to both high and low priority for forests, sparsely vegetated lands, and soils, indicating diverging views within the sector. Inland wetlands were seen as in need to be highly prioritised by the highest number of respondents in Poland (66 %), closely followed by freshwater (52 %) and urban ecosystems (57 %). Low priority was given to sparsely vegetated lands by 31 % and to forests by 27 %, although the latter also obtained significantly more high priority responses.

Open-text comments added as priority the urban-rural interface and issues facing agricultural lands such as industrial farming, encroachment from cities and the impacts of climate change. Many respondents considered that forests were low priority by comparison with agriculture ecosystems. Many Polish respondents expressed concerns over definitions of ecosystem types, ‘semi- natural’ and ‘natural’ state of forests.

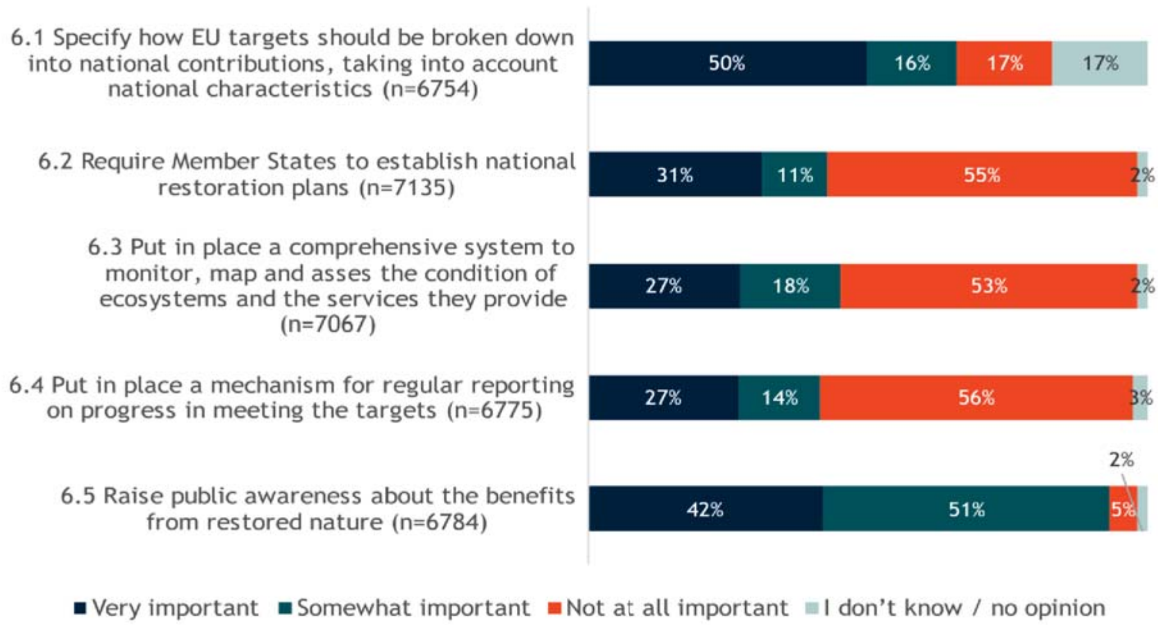
Question 6. *How important do you consider the following factors and measures for ensuring that future EU restoration targets are delivered?*

Figure 2-13 OPC responses to Question 6 (all responses)



As visible from Figure 2-13, campaign responses focused on options 6.1, 6.2 and 6.4 and considered national restoration plans and progress reporting as very important factors to ensure delivery. Conversely, most respondents considered option (6.1) 'not at all important' to ensure delivery.

Figure 2-14 OPC responses to Question 6 (without the #restorenature campaign)



Specifying how EU targets should be broken down into national contributions taking into account national characteristics (6.1) was deemed to be very important by half of the respondents, and somewhat important by further 16 %. However, the highest number of respondents selected raising public awareness as a somewhat or very important measure. Notably, the majority of respondents considered that a mechanism for regular reporting on progress in meeting the targets, a requirement for Member States to establish national restoration plans, and a comprehensive system to monitor, map and assess the condition of ecosystems and the services they provide were not at all important.

Table II-1 below gives an overview of converging responses per stakeholder type across the various options.

Table II-1 Responses per stakeholder type to question 6

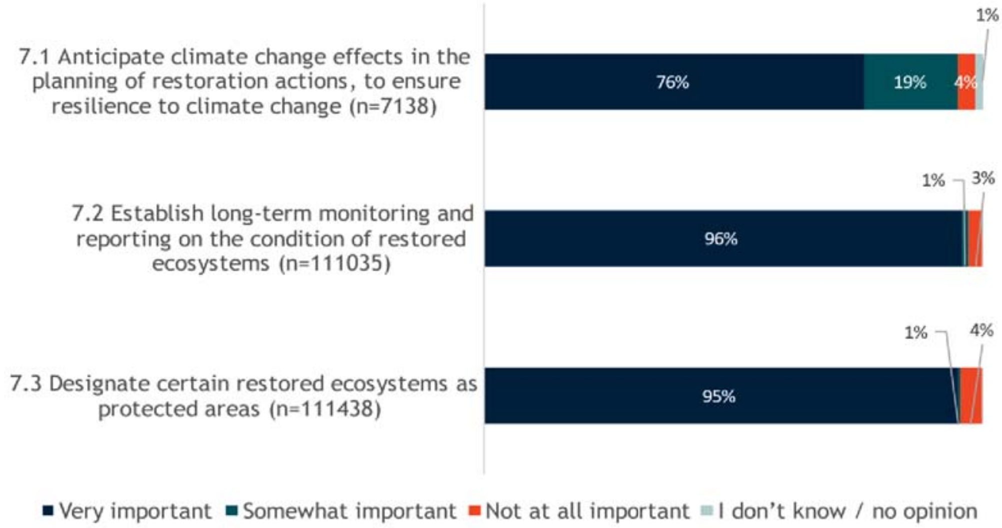
Question Response	6.1 Very important	6.1 Not at all important	6.2 Very important	6.2 Not at all important	6.3 Very important	6.3 Not at all important	6.4 Very important	6.4 Not at all important
Agriculture	9 %	5 %	9 %	6 %	9 %	6 %	9 %	6 %
Civil protection	1 %	1 %	1 %	1 %	1 %	1 %	1 %	1 %
Culture	13 %	9 %	16 %	9 %	17 %	9 %	16 %	9 %
Education	6 %	6 %	9 %	4 %	10 %	4 %	9 %	4 %
Energy	1 %	1 %	2 %	1 %	2 %	0 %	2 %	1 %
Environment	13 %	11 %	18 %	8 %	18 %	8 %	19 %	8 %
Fisheries and aquaculture	1 %	0 %	1 %	0 %	1 %	1 %	1 %	0 %
Food	1 %	1 %	2 %	1 %	2 %	1 %	2 %	1 %
Forestry	45 %	58 %	26 %	57 %	24 %	59 %	23 %	61 %
Health	2 %	2 %	4 %	1 %	4 %	1 %	4 %	1 %
Industry	3 %	2 %	4 %	3 %	4 %	3 %	4 %	3 %
Insurance	1 %	0 %	1 %	0 %	1 %	0 %	1 %	0 %
International cooperation	0 %	0 %	1 %	0 %	0 %	0 %	0 %	0 %
Mining	0 %	0 %	0 %	0 %	0 %	0 %	0 %	0 %
Spatial planning	1 %	1 %	1 %	0 %	1 %	0 %	1 %	0 %
Tourism/ leisure	2 %	1 %	3 %	1 %	3 %	1 %	2 %	1 %
Trade	1 %	1 %	2 %	1 %	2 %	1 %	2 %	1 %
Transport	1 %	1 %	1 %	1 %	1 %	1 %	1 %	0 %
Waste	0 %	1 %	1 %	0 %	1 %	0 %	1 %	0 %
Other	11 %	10 %	15 %	8 %	16 %	7 %	16 %	7 %

Polish forestry sector respondents gave clear preference to option 6.1 and 6.5, while 6.2, 6.3 and 6.4 obtained a clear majority of 'not at all important' responses.

Open-text comments varied from stressing that Member States should be responsible for setting the target as well as monitoring and evaluating its progress to advocating for an emphasis on the overall health of habitats rather than on specific species protection, taking into account social and economic aspects, sustainable farming and forestry.

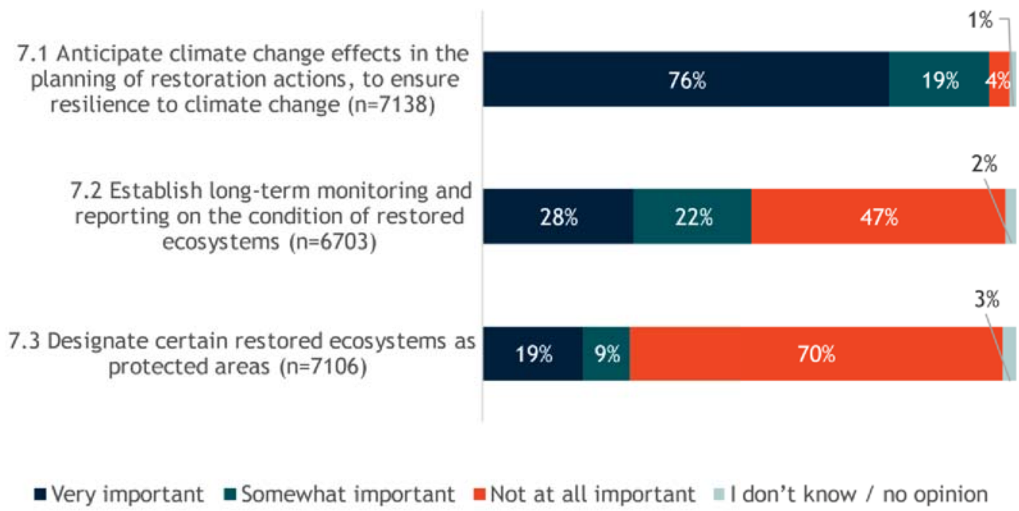
Question 7. *What measures are needed to ensure that restored ecosystems are kept in good condition in the long term?*

Figure 2-15 OPC responses to Question 7 (all responses)



Campaign responses were directed only at options 7.2 and 7.3, as 'very important'. Overall, the majority of responses highlighted all measures as 'very important'.

Figure 2-16 OPC responses to Question 7 (without the #restorenature campaign)



The ranking of the proposed measures differed greatly. Opinions were split on the importance of monitoring and reporting on the condition of restored ecosystems. Open -text comments stressed the urgency to actively restore certain ecosystems and thus favoured active versus passive measures overall. Comments referred again to sustainable management practices and economic considerations adding that strict protection could lead to greater ecosystem loss.

Question 8. *Open question*

Question 8 of the OPC invited respondents to add further detail or information. A list of unique responses was generated in order to exclude campaigns, and screened to extract responses above a given character threshold in order to provide substantive text. Following this initial filter, the formula randomly selected a set of 50 responses per evaluation question. These responses were checked again to indicate possible coordinated replies. Respondents discussed passive versus active restoration and provided arguments and examples in favour of both. Other comments highlighted economic and social sustainability and including local needs. In addition, 20 attachments were submitted to the OPC in relation to the Impact Assessment. They were analysed and summarised at the stakeholder group level below. Ten of these came from academic/research institutions, 5 from environmental NGOs, and 5 from company/business organisations.

Academic/Research Institutions

Country of origin	**Organisation**	**Feedback summary**
Italy	Academic paper	EU policies and initiatives must preserve biodiversity but also meet the demands of local people.
Italy	Academic paper	An integrated strategy should consider ecosystem preservation and rural socio-economic development.
Italy	Academic paper	Green infrastructure and in particular green roofs are crucial for sustainable urbanisation (reviews of German, Swiss and Italian guidelines).
Greece	Conference on the Ecological Importance of Solar Saltworks CEISSA	Consider Solar Sea Saltworks as Constructed Wetlands and include them in the list of protected ecosystems where human intervention helps maintain and safeguard biodiversity and wildlife.
Germany	Institute for Rural Development Research	(Translated). Argues for integrated rural development focus on agriculture, heathlands and water in rural areas.

Country of origin	Organisation	Feedback summary
Germany	Thünen Institute	(Translated) The implementation of protection and restoration measures in forests will have a direct impact on the production of raw wood in the EU member states. It is to be expected that at least part of the raw wood production will be relocated to third countries with a fundamental risk of biodiversity loss. These global biodiversity losses must be set against the biodiversity gains in the EU.
Poland	University in Poznań	(Translated) Priority should be given to tackle the widening gap between science, administration, NGOs; insufficient educational activities for nature conservation; the lack of mechanisms to encourage biodiversity conservation other than by designated actors.
Sweden	Stockholm University Baltic Sea Centre	Policies for healthy and productive marine environments and fishing need to be better coordinated. The quality of management in protected areas is key.
The Netherlands	(Translated) Strategy to conserve meadow birds on modern, intensive dairy farms in the Netherlands is to restrict farming intensity and compensate farmers for their production losses. To increase the breeding success of meadow birds, however, dairy farmers can fine-tune farming practices to yearly and local circumstances.	
Germany		(Translated) The market is the most consequential institution of all time, to be borne in mind when considering societal impacts and legislation.

Environmental Organizations

Country of origin	Organisation	Feedback summary
Belgium	European Environment Bureau (EBB)	Proposed overall EU target to restore 15 % of the EU land and sea area (with defined menu of ecosystems to restore), 15 % of all rivers to be restored to free flowing state as well as a target for CO2 removal by restored natural sinks, in addition to the 2030 emissions reduction target. These targets should be met at Member State level, i.e. without effort sharing, so that all Member States contribute

Country of origin	Organisation	Feedback summary
		their fair share and to ensure ecological coherence. If there are ecosystem-specific targets, they need to focus on biodiverse ecosystems with significant carbon storage and sequestration potential, such as peatlands, floodplains, wetlands, old-growth forests, biodiversity-rich grasslands, free flowing rivers and coastal areas or marine ecosystems. Ecosystem specific targets need to be consistent with the EU overall restoration target.
Belgium	Restoring Nature Campaign	Recommendations on elements of the restoration law stressing also that the law must result in urgent large-scale restoration across the EU and should be additional to the relevant EU Directives so as to not undermine or duplicate existing obligations that include some restoration requirements.
The Netherlands	House Sparrow Conservation Holland	Ensure house sparrow protection. EU legislation concerning biodiversity should provide in regulations to uphold similar legislation at state level.
Belgium	Wilderness Conservation Society Europe (WCS- EU)	Very little has been done in the last decade to reduce the impacts of EU consumption on biodiversity outside of the EU. More funding and legislation is needed to support sustainability in Africa and Latin America.
Belgium	Free Rivers Europe	Complements the position paper 'Restoring EU's nature' released by a coalition of 20+NGOs in October 2020 and proposes elements to be considered as part of the nature restoration law related to the protection and restoration of free-flowing

Country of origin	Organisation	Feedback summary
		rivers and freshwater ecosystems.

Business Associations

Country of origin	Organisation	Feedback summary
Spain	SALIMAR	Recognise sea salt marshes as protected ecosystems where a perfect symbiosis between industry and environment takes place.
Germany	Familienbetriebe Land und Forst	(Translated). Family farms support the goals of the EU Green Deal for climate and species protection but these can only be achieved with the instruments of an ecologically social market economy: protection of ownership, freedom of contract, competition, innovation, entrepreneurship.
UK	Sustainable Biomass Program	Lessons learned from the Programme, both in terms of principles that underpin a biomass certification scheme and principles that are advocated for better regulation of biomass
USA	US Industrial Pellets Association-USIPA	Sustainable woody biomass can play a crucial role in delivering the EU's goals while protecting the environment and promoting healthy and growing forests. The sustainability of the biomass and use is paramount.
Belgium	FORTUM	Climate change mitigation and adaptation and their impact must be considered when setting targets; Member States should have discretion to choose their national contribution to overall target, existing frameworks should be utilized in order to avoid creating new administration, interlinkages of restoration targets and water legislation must be reviewed.

2.2.3. Campaigns identified in the OPC

- ***#restorenature.eu***

During the analysis of the OPC responses, one major campaign was clearly identified. It mobilized the overwhelming majority of responses (104 333 identical inputs) to the survey on EU nature restoration targets. This campaign was jointly organised by a coalition of NGOs including BirdLife, the EEB and WWF EPO and included a **dedicated webpage**[5], with a pre-filled response available in six languages (English, French, Spanish, German, Italian, and Dutch). The quantitative responses are shown below. In addition, identical open text responses were provided through the campaign, as highlighted in the table below.

Table II-2 Identical open text campaign responses identified

OPC Question	Response
2.9	EU must adopt a new law enabling landscape level restoration of high-quality nature leading in due time to biodiversity rich and functioning habitats.
3	The law must exclusively cover restoration of ecological functions and connectivity of habitats and promote natural ecosystem dynamics, with a main focus on ecosystems with significant carbon storage and adaptation potential.
	Focus must be on fundamental land and sea use change that can put nature on a path to sustaining 'high quality'. Improvements of productive systems like agriculture, soil, commercial forestry or fishing should be tackled by other legislation.
4	At least 15 % of EU land and sea area and 15 % of free-flowing rivers must be restored by 2030. The law should also include a target for CO_2 removal by restored natural habitats acting as sinks, on top of 2030 emissions reduction target. The 15 % target must apply equally to each Member State.
5	Restoration definition must be narrow and not include improvement of agricultural soils/urban greening which should be addressed by other policies. It should focus on peatlands, wetlands, forests, grasslands, rivers, floodplains, marine ecosystems.
6.6	We need detailed science-based national restoration plans, to be assessed and approved by the Commission, to ensure their quality and consistency.
7.4	The law should encompass active (e.g. dam removal) and passive (e.g. fishing bans, logging bans) restoration. These restoration activities can be undertaken inside or outside protected areas, in which case Member States should guarantee the long-term protection and improvement of the restored habitats.
8	National restoration plans need to show how restoration measures will support: Improved connectivity of Natura 2000; achieving target of 10 % of EU's land and sea area to be strictly protected; climate change adaptation and mitigation (in particular through water retention to help deal with increasing floods, droughts and sea level rise); objectives of existing legislations (e.g. BHD, WFD, MSFD) while being additional to existing legal requirements; Public participation. The law must contain clear deadlines for the restoration plans and restoration measures, for the approval of the plans by the Commission and for the involvement of interested stakeholders and scientific experts. Monitoring of restoration measures, biodiversity outcomes and progress to targets, through standardized, and frequent national reports will be key.

[5] http://www.restorenature.eu/

	The new law should support the use of existing EU funds and the creation of a dedicated EU restoration fund (or facility within some other fund in the future MFF).

- Once the respondents mobilised via the #RestoreNature campaign were isolated, most of the remaining respondents were found to originate from Poland (90 %) and more than half of the respondents specified forestry as their main field of activity (55 %). More careful analysis revealed that, while the wording of qualitative answers differed slightly between these respondents, it conveyed very similar meaning. In the absence of an officially announced campaign in this Member State and sector, the survey analysis team neither confirms nor rules out possible coordinated action(s). Nevertheless, a bias in the stakeholder representation is significant and needs to be borne in mind when considering the survey feedback.

2.3. Consultation workshops

There were **five consultation workshops** held addressing the following topics:

- Workshop 1: key concepts, restoration needs and presentations on existing restoration activities in the Member States, 9 December 2020 (Member States only).
- Workshop 2: ecosystem-specific restoration targets, 23 February 2021, 185 participants
- Workshop 3: overarching goal and key definitions, 14 April 2021, 198 participants
- Workshop 4: enabling measures, the content of National Restoration Plans (NRPs) and non-deterioration, 25 May 2021, 158 participants
- Workshop 5: options for targets considered in the impact assessment, likely impacts on diverse groups and measures to increase stakeholder engagement and support for implementation. This workshop took place on 8 September 2021 and consisted of two separate half-day sessions: one with stakeholders, and one with authorities from the Member States only.

Overall, about 150 to 200 stakeholders from Member State authorities, NGOs, stakeholder associations, research and academia institutions and European Commission services attended each of the workshops. The Membership list of the Coordination Group on Biodiversity and Nature (CGBN) was initially used as a basis to invite stakeholders. CGBN is the main Expert Group coordinating the implementation of EU biodiversity policy with over 100 member organisations including 40 national authorities from Member States, 9 other public entities such as international and inter-governmental organisation, 47 stakeholder organisations including NGOs, businesses, sector associations and research institutes, as well as individual experts. For the first workshop, only national authorities from this list were invited, who then liaised with colleagues from agriculture, forestry and other ministries who then also registered. The following workshops included stakeholders, starting with the CGBN list, adding further stakeholders upon request, and maintaining these registered participants on the lists for subsequent workshops. Noting the variety of stakeholders who participated, it can be confidently said that the identified stakeholder groups have been reached. A CIRCA site was set up to share workshop materials and minutes with the participants. The main views expressed by different stakeholder representatives during these workshops are summarised below:

Overarching goal and ecosystem-specific targets

- National authorities showed diverging views. Some prefer to enhance restoration requirements under existing legislation and improve EU-level coordination. Others prefer an overarching aspirational goal set at EU level coupled with ecosystem-specific targets set at the national level, so that they can decide what ecosystems to restore. Others welcome legally binding ecosystem-specific targets at EU level. Some support for targets going beyond HD Annex I habitats, in step 1 already. Some prefer process targets over outcome targets.
- Nature NGOs showed converging views with strong support for legally binding SMART ecosystem-specific targets, while an overarching goal was considered beneficial but less important. They further gave broad support to both process and outcome targets that go beyond Habitats Directive Annex I and cover all EU habitats. An overarching restoration target of restoring 15% of degraded ecosystems by 2030 was seen as too low, with NGOs suggesting a target to restore 15% of the EU land and sea area, and restoring 15% of rivers to a free-flowing state.
- Associations of stakeholders (agriculture, forestry and forest owners) indicated preference for soft measures over legally binding instruments, underlined the need to respect ownership rights and promoted a voluntary bottom-up approach.
- Research representatives welcomed both an overarching goal and specific targets that are legally binding, as previous targets haven't worked.
- Further points raised in the discussion on this subject included area-based targets and the need to set milestones for restoration.

Step-wise approach (i.e. set targets for ecosystems where sufficient evidence exists, and further monitoring and assessment to set targets for other ecosystems later):

- National authorities: broad support for a step-wise approach to ensure positive results in step 1 for a number of ecosystem types.
- Nature NGOs: underline the need for quick action but inquire about mechanism for the second stage.
- Research institutes: scientific knowledge is available to support the restoration of priority ecosystems.

Enabling measures including National Restoration Plans (NRPs)

- National authorities: Some support for NRPs. Several underline their importance for ensuring finance, e.g. at EU level. Call for clarity on the financing need. One Member State warned not to count on private finance too much considering experience with the NCFF.
- Nature NGOs: Broad support for NRPs with clear content requirements and review process with role for the Commission to ensure consistency. One underlined need for

intermediate plans to enable quick action. Some underlined that financing restoration is an investment in job creation, health, etc. Asked about specific EU funds for restoration.

Prioritisation

- National authorities had diverging opinions, from prioritising ecosystems with the most unfavourable status to those with the most human health benefits. Some also referred to cost-effectiveness, given limited resources, and to the need for a common prioritisation framework.
- Views of nature NGOs included the need to prioritise benefits to biodiversity over benefits to climate, and the importance of ecosystem services that are not easily quantified or monetised.
- Research institutes also referred to the importance of prioritising and communicating about restoration benefits to people.

Ecosystem-specific targets

General outcomes of the second consultation workshop:

- Remarks on targets across all ecosystems: (1) they should consider connectivity of ecosystems; (2) they should be in addition to existing legislation and (reporting) obligations, and help enforce these; (3) they should encompass a mix of dimensions, from EU level to ecosystem specific; (4) they need to be based on robust baselines where possible while urgently collecting lacking data; (5) they should allow for different local contexts; and (6) they should feed into an overarching EU level target.
- Individual session outcomes: <u>Fresh water ecosystems and inland wetlands</u>: targets should complement the WFD and Nature Directives, for example on overcoming barriers to achieve continuity and on restoring connectivity between ecosystems beyond the main channels where the net returns are the highest. <u>Marine ecosystems</u>: there should be a mix of targets that cover both specific habitat types and marine biodiversity elements beyond fishing while considering the transboundary nature. <u>Urban ecosystems</u>: there is major potential for restoration, through connectivity and integrative approaches in urban planning, and there are several candidate targets. <u>Forests</u>: targets should be specific and include forest resilience, reforestation and afforestation in places with high potential for biodiversity, connectivity and ecosystem services. <u>Agroecosystems</u>: there should be a mix of measurable targets that contribute to both biodiversity and ecosystem services, and be a catalyst for sustainable agriculture under the CAP. <u>Pollinators</u> (horizontal function across ecosystems): we need to start restoration measures based on available data, while simultaneously developing additional indicators/data. <u>Soil</u> (horizontal function): soil restoration can take a long time so focus on action-oriented targets on a few impact indicators, which can be incorporated into ecosystem targets.

Specific stakeholder views presented during other consultation workshops:

- Some national authorities underlined positive (voluntary) experiences but also the complexity and cost of restoring peatlands. Further points made concerned the need to consider the risk of creating habitat for vectors of diseases; the need for targets on urban ecosystems, soils and rewetting; the CAP targets on farmland birds and soil organic carbon.
- Nature NGOs expressed broad support for targets on agro-ecosystems, considering that they comprise 39% of EU land and are of importance for biodiversity. Different organisations supported targets on wetlands, urban ecosystems (especially on abandoned land), rivers (particularly on free-flowing rivers, keystone species such as eel) and pollinators, as well as the importance of passive restoration for marine ecosystems.
- Associations: an organic farming association underlined that ecosystem restoration and food production are no contradiction, considering the reliance on biodiversity and welcomed targets and indicators on pollinators, farmland birds and soil health. A small-scale farming association warned that intensive farmers would be paid to restore degraded agro-habitats due to intensive farming. A forestry association underlined the importance of reaching favourable status of forests also in light of climate benefits.
- Some research stakeholders welcomed urban restoration as a means to bring benefits close to the people.

Monitoring and EU-wide approach

- Some national authorities emphasized the importance of coherence and data comparability. Suggestions were made to streamline monitoring with the Prioritised Action Frameworks under the CAP, and to build on the Mapping and Assessment of Ecosystems and their Services (MAES).
- A nature NGO pointed out the need for a common approach (indicators, methodology) if the legislation goes beyond Annex I of the Habitats Directive.
- A forestry association underlined the need for improved monitoring of ecosystem condition (data and methods) and reporting under existing systems.
- Research stakeholders offered support and underlined need to zoom into regional rather than national level.

Non-deterioration

- National authorities underlined the importance of reducing pressures.
- Nature NGOs underlined the importance of ensuring no deterioration of both ecosystems that are restored and those that are to be restored (by reducing pressures, such as bottom trawling).
- Forestry favoured a passive approach to restoration, as opposed to one that requires subsidies and management.
- Research stakeholders pointed out that some pressures, like erosion and agricultural intensification, cannot be stopped immediately.

Policy coherence

- Several national authorities called for the restoration proposal to ensure links with other legislation such as the BHD, WFD, MSFD, Taxonomy Regulation and CAP.
- Nature NGOs: some call for the legal proposal to consider links with CAP, CFP and MSFD. Some expressed concerns about the legal proposal potentially postponing the 2020 deadline to achieve good status under MSFD to 2050.
- Associations: an organic farming association underlined the need to consider links with LULUCF.

On the coverage of the options for targets, main ecosystem types and restoration ambition:

– Conservation organisations expressed satisfaction with the overall direction of the targets, a focus on Annex I of the Habitats Directive for Step 1 and the combination of restoration + recreation of ecosystems + bird targets. Conservation, academic and protected area management organisations also emphasized the importance of **ecological connectivity**, the needs of **migratory species** and targets for **vulnerable species** that are difficult to restore. Member States authorities and stakeholders alike pointed to the need to ensure that the targets work in synergy among themselves and with EU legislation and policies. A number of environmental NGOs noted that ecosystems considered for **step 2** only have a monitoring obligation and suggested a non-deterioration obligation to be added.
– **Forestry sector representatives** questioned whether targets could be set without knowing the location and the concrete measures, which would allow an assessment of their feasibility. Some conservation organisations considered the target to complete all necessary marine restoration measures by 2050 unrealistic considering maritime activities and climate change.
– Restoration experts pointed to the need for linkages with instruments such as **protected areas** and **spatial planning**, which could be emphasised in the NRPs.
– A potential risk was identified by experts in environmental organisations and authorities in relation to a target to increase **Soil Organic Carbon**, which could be detrimental if applied to vulnerable habitats with naturally poor soils (such as dunes): it should be properly interpreted.
– Environmental organisations called for an emphasis on the 2030-2040 period in terms of contributing to the biodiversity and climate targets rather than to 'back-load' the ambition. They also emphasized that all targets should consider the **impact of climate change** and with this the evolution of ecosystems and invasive species.
– Several Member States authorities envisaged difficulties in implementing restoration beyond Natura 2000. At the same time, several Member States asked for more ambition to ensure ecological connectivity and for extending the focus beyond natural habitats (Annex I), to cover green infrastructure and diversify agricultural landscapes. One Member State suggested a separate target on high-diversity landscape features as in the Biodiversity Strategy). It was suggested that targets should be considered for intermediary steps towards more naturalness, e.g. to move away from monocultural forests and towards more natural rivers, and that restoration provisions do not lower the ambition of existing requirements.

On the impact of the targets on stakeholders and how to engage stakeholders:

– Several stakeholders pointed to the need to be clear on **who would be responsible to implement** the targets and obligations. Two NGOs commented that the burden of implementation should be placed not only on the nature authorities, but also on other relevant administrations (e.g. water).

– **Forest owners and forestry sector stakeholders** expressed support for a focus on restoration measures rather than on results. The need to ensure respect for **property rights** in the implementation of the targets at the national level was underlined, in relation to restoration on private land that needs prior and informed consent of the owner. They emphasized that, in order to bring forest managers and owners on board, proper consultation and support are needed including finance to compensate them for costs that bring broad benefits to society. Forestry sector stakeoholders further stressed the need to consider impacts **in the value chain**. National forest acts already pose mandatory obligations on forest owners such as for the recovery of stands after disasters or harvesting, and for the removal of dead biomass.
– An environmental NGO in the Baltic Region pointed to likely impacts from restoration on fishermen, the recreational sector and other commercial sectors such as shipping, boating and energy production, for instance by displacement of their activities. New conflicts may arise with restoration when predators return and compete with human uses, making enemies from former allies (such as small fishers). Possible conflicts were also flagged with the objectives of the **Common Fisheries Policy**.
– The need to **involve stakeholders** such as farmers and private land owners, as well as the challenges in this regard were stressed by most Member States during the consultations. Conflicting policy priorities and pressure from other sectors were also highlighted. One Member State expressed concern about the feasibility of mapping the area to be restored in the National Restoration Plan, before having carried out extensive discussions with stakeholders, as this would provoke a lot of reaction. This raised also the question of **funding** for compensation, restoration, management and other related measures.
– **Private forest owners** called for an open approach when planning restoration measures in order to build trust and support. **State forestry representatives** emphasized that restoration needs to be integrated with rural economies. A representatives of an environmental NGO stressed that ecosystem restoration is becoming a matter of survival, turning the tide on the nature crisis. Environmental NGOs saw restoration as a positive agenda for solutions, but noted that the benefits for various stakeholders should be made more visible: farmers, fishermen and foresters will be harmed if we don’t act on climate change.
– Several workshop participants from the non-governmental sector pointed to the need to diversify the economic sector to engage with the restoration agenda. For example, the national restoration plans could include new economic activities and business models that would provide alternative livelihoods.

2.4. Ad hoc contributions

Several national authorities and stakeholders made use of the possibility to send input by mail or schedule a meeting with the Commission, including:

- The Norwegian Ministry of Climate and Environment, which expressed support for and commitment to restoration of freshwater and wetland ecosystems, and outlined current restoration activities and plans.

- The Dutch Ministry of Agriculture, Nature and Food Quality, which inquired about the process, timeline, nature of the targets, governance, and envisaged requirements to submit a National Restoration Plan.

- The Finish Ministry of Environment, which asked for clarifications on the targets, the added value of the legal instrument and spatially-explicit areas, and suggested to take account of subsidiarity, consider funding, definitions, time lag of recovery, and overlap/synergies with other policies such as the CAP.

- BirdLife, EEB, WWF and ClientEarth, which advocated for a restoration law that builds on and goes beyond (ecosystems covered under) existing legislation.

- BugLife, which underlined the need for connectivity / reducing fragmentation (including a target to reduce average distances between habitat fragments), in an approach that caters for easy planning and monitoring, informs decision-makers and is easily understood.

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Brussels, 22.6.2022
SWD(2022) 167 final

PART 4/12

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

ANNEX VI-a

Accompanying the

proposal for a Regulation of the European Parliament and of the Council

on nature restoration

{COM(2022) 304 final} - {SEC(2022) 256 final} - {SWD(2022) 168 final}

EN EN

Annex VI: Analysis by ecosystem

(VI-a: Chapters 1-5)

Summaries of Impact Assessments of ecosystem-specific EU restoration targets

Table of contents:

Because of its size, annex VI is split in two parts.

See Annex VI-b for the following chapters:

1. Inland wetlands

1.1 Scope

This assessment covers 'inland wetlands' which are defined here according to the EUNIS habitats[1] classification as 'Mires, bogs and fens'. These wetland categories can be divided into two very different groups: peatlands and inland marshes.

Peatlands (EUNIS D1, D2, D3 and D4) are categorised by their development of a layer of peat[2] (i.e. partly decomposed plant material), which builds up because of waterlogged conditions. Peatland wetlands mainly occur in cool and wet climates in north-west Europe. They are largely covered by the habitat types of EU importance that are listed in Annex I of the Habitats Directive (HD). Twelve HD Annex I habitats comprise peatlands.

Due to their peaty substrates, this impact assessment also considers two wet heathland, one wet grassland and two bog woodland HD Annex I habitats together with the EUNIS peatland wetlands. Together, these eighteen HD Annex I peatland habitat types cover approximately **136 572 km^2** in the EU (**3.6 %** of the EU terrestrial area)[3].

Inland marshes (EUNIS D5 and D6) are nutrient rich wetlands that are characterised by emergent rooted vegetation such as reeds (e.g. *Phragmites* spp). They are widely distributed in Europe, typically occurring around lakes, rivers and lagoons, in floodplains, and in areas with permanently or temporarily high groundwater levels. HD Annex I habitats do not include any inland marsh habitats. Some coastal and inland salt meadows / marshes are classified as HD Annex I habitats, and these are included in the impact assessments covering coastal habitats. According to CORINE data, inland **marshes cover 10 641 km^2** in the EU.

Detailed data on the geographical distribution, area (km²), conservation status and condition of inland wetland habitat types of Annex I of the Habitats Directive in EU Member States is provided in Annex VIII-a.

1.2 Problem, current trends and ecosystem-specific baseline

Inland wetlands are widely considered to be of very high importance for their biodiversity and associated ecosystem services. As such they have been the focus of longstanding nature conservation action, in particular through the Ramsar Convention on Wetlands of International Importance signed in 1971. This has been in response to widespread losses. For centuries, wetlands, especially peatlands, were targeted for drainage and conversion to agriculture, resulting in two-thirds being lost across Europe between 1900 and the mid-1980s[4]. Consequently, they receive very high coverage under the EU Nature Directives, as most peatlands are HD Annex I habitat types. Europe holds a relatively large proportion of some types of the world's peatlands.

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[1] EUNIS habitat types

[2] Generally considered to be "A wetland soil composed largely of semi-decomposed organic matter deposited in-situ, having a minimum organic content of 30 % and a thickness greater than 30 cm." Finlayson & Milton (2016).

[3] According to the State of Nature report 2020 - Area of habitats calculated from the area reported by Member States (but excluding Romania due to their severely overestimated data) as 'best estimate' or 'average of minimum/maximum'; minimum area is 133 640 km^2 and the maximum area is 142 511km^2.

[4] European Commission COM(1995)189 final: Wise Use and conservation of wetlands.

Marshes are particularly important for birds listed on Annex I of the Birds Directive, as well as other migratory species that require special conservation measures under the Directive.

Peatlands are of particular importance for their carbon stores, because peatlands in good condition store more carbon per unit area than any other ecosystem, while they become important net carbon emitters when inappropriately managed. All wetlands, and especially upland peatlands, also provide a wider range of ecosystem services. Of these, water retention (which helps maintain supplies during droughts and alleviates floods during extreme weather events) and water filtration are considered to be the most important.

Despite the EU Nature Directives providing high coverage to such habitats and their associated EU protected species, the vast majority (**84 %**) of the peatland habitat type assessments at EU level made in the frame of the State of Nature reporting in the period 2013-2018 revealed an **unfavourable conservation status**: 32 % poor and 52 % bad. Furthermore, at the EU level, **55 %** show an unfavourable **deteriorating** trend. According to the European Red List of Habitats[5], all but two of the 13 EUNIS mire habitat types (85 %) are threatened to some degree, which is the highest proportion of any terrestrial and marine groups of habitats.

Member State reports on the condition (i.e. the quality) of habitat types, indicate that at least 14 % of the total peatland area is known to be in not-good condition. However, almost 48 % of the total area of the habitat area is reported as in 'unknown' (or not reported) condition. The true proportion in a poor condition is more likely to be the proportion of the total habitat area where Member States reported on the condition of the habitat that had a not-good status. Therefore, **it is assumed that 27 % of the habitat area is in a poor condition (i.e. 36 874 km^2).**

According to Member States reports for 2013-2018, the top three groups of pressures affecting HD Annex I peatlands were inadequate habitat management (e.g. grazing, burning, tillage), different forms of water/soil/air pollution (direct or diffuse), and drainage and water abstraction for different purposes (e.g. agriculture, human consumption).

The condition of marshlands and the pressures affecting them are less well known as they are not Annex I habitats and are not subject to standardised EU level monitoring and reporting. CORINE land cover data suggests that the previous extensive losses of wetlands due to drainage have largely halted (probably in part due to high Natura 2000 coverage). On average peatlands declined by 0.03% each year between 2000 and 2018, whilst marshlands increased slightly. In accordance with the baseline 2030 scenario for this impact assessment, whilst small scale losses of some wetlands are expected to continue, they may decline due to improved protection, and some wetland expansion is expected. Therefore, this assessment assumes **no further significant net loss of Annex I peatlands or marshlands to 2030**. However, the trend in increasing wetland fragmentation is predicted to continue.

Nevertheless, evidence of pressures on wetland species suggest that a substantial proportion of marshlands are degraded and requiring restoration mainly due to hydrological modifications and low water tables (e.g. due to diversions for hydropower or abstraction for agriculture). Whilst some

[5] Janssen et al (2016) European Red List of Habitats Part 2. Terrestrial and freshwater habitats. European Commission.

pressures are stable or declining (such as nitrogen deposition) and improved river catchment management is expected under the Water Framework Directive, there is little indication of large-scale restoration. On the contrary, the trend in condition of Annex I wetlands is showing that while only 4% of the assessments show an improving trend, 29% show a deteriorating one. Furthermore, direct and indirect climate change impacts (e.g. increasing water demands) will increase, and exacerbate existing pressures. Therefore, **it is assumed that degradation levels in HD Annex I peatlands will increase slightly, from 27 % to 30 % by 2030**. It is assumed that **by 2030 50% of marshlands will be degraded, lowering their ability to provide habitat for EU protected species.**

1.3 Target options screened in/out

Based on the importance of the ecosystems for biodiversity and ecosystem services, and their current levels of degradation, four broad over-lapping restoration objectives are evident for HD Annex I peatlands as set out in the Table I-1 below. In practice, these biodiversity and ecosystem service objectives are closely related and require very similar restoration actions. The achievement of each objective would also synergistically contribute to other objectives.

Therefore, as the main aim of the restoration targets is to restore ecosystems for biodiversity, option 1 (presented below) is taken to be the primary goal and the basis of the target, with the other objectives achieved as a co-benefit. However, given the slow recovery of peatlands to good condition (which would require a long-term target), and the exceptional importance of reversing the losses of carbon stores from peatlands, it is recognised that **re-wetting peatlands that are degraded Annex I habitats is a particularly urgent priority sub-objective**. A restoration and **rewetting target for degraded peatland under agricultural land (cropland and grassland) is included in the soil section** of the impact assessment, with an important difference in target conditions: while the peatland target of this section is fully focused on the recovery of Annex I habitats, the target assessed in the soil section (on peatland under agricultural use) is still about the restoration and rewetting of peatlands but not requiring that Annex I habitat quality is reached necessarily.

The context and rationale for the restoration and re-creation of **marshlands** is very different to that for HD Annex I peatlands. This is primarily because their main biodiversity value is being a habitat for a wide range of EU protected species. **As a result of this, it is appropriate for the EU restoration target to focus on the (measurable) recovery of EU protected species populations** by restoring their habitat rather than achieving ‘good condition’ of the habitat. Furthermore, there are no current monitoring mechanisms which report on the condition of these habitats. It would also be appropriate to focus on those species that are most dependent on the habitat and its restoration to achieve their favourable conservation status for HD species and secure status for birds. As the list of EU protected species of marshlands includes a large number and variety of species that are dependent on such habitats, it can be expected that their conservation and recovery would also indirectly provide substantial benefits for a wider range of other species. Overall, the species objectives would lead to improvements in the ecosystem as a whole, and related ecosystem service benefits (e.g. improved water resources and quality, flood alleviation, fish production, sport hunting, nature recreation).

As regards EU protected species predominantly associated with peatlands, the achievement of favourable conservation status of HD Annex I peatlands would be expected to meet most requirements for their recovery. Whilst some of these species may require specific habitat actions, there would be little added value of a species-focused habitat restoration target for them. Similarly, there would be little added value from extending the EU protected species target across all wetlands, as peatlands and marshlands and their species communities, and restoration requirements differ considerably. Therefore, the EU protected species target is only considered for marshlands.

Table I-1: Summary table of screened target options

Target option	Screened in/out for assessment	Key reason(s) for screening in/out
HD Annex I peatlands		
1. Achieving the favourable conservation status of Habitats Directive Annex I peatlands.	Included as primary goal of restoration target	Biodiversity is the primary aim of the nature restoration policy, and this objective will in addition fully meet the objective for carbon if urgent re-wetting is undertaken
2. Increasing carbon sequestration and storage in Habitats Directive Annex I peatlands.	Included as an urgent re-wetting measure, as a sub-objective of Option 1	Could be achieved as an urgent measure under Option 1.
3. Improving water retention in wetlands in flood prone catchments (potentially linking to the targets for rivers and associated habitats).	Not included	Largely achieved under Option 1, with targeting to appropriate areas
4. Improving raw water storage and quality in catchments supplying drinking water.	Not included	Largely achieved under Option 1, when targeting to appropriate areas
Marshlands		
5. General habitat restoration and re-creation of marshlands	Not included	Definition of good condition is primarily dependent on its suitability for key species (therefore largely covered by target option 7.)
EU protected species		
6. Achieving favourable conservation status of protected species predominantly associated with HD Annex I peatlands	Not included	Would provide little added value by itself and would not cover a large number of EU protected species of marshlands.
7. Achieving favourable conservation status of protected species predominantly associated with marshlands	Included	Complements the objective for HD Annex I habitats
8. Achieving favourable conservation status of protected species predominantly associated with all wetlands	Not included	Would cover habitats with very different species and habitat requirements without adding value.

Peatlands

Based on the above considerations, and the high priority for restoring degraded habitat areas, this impact assessment considers the following potentially feasible targets:

- The full recovery of Habitats Directive Annex I peatlands to good ecosystem status (i.e. favourable conservation status), including through the following:

- Restore all HD Annex I peatland habitat area to good condition (thereby also restoring relevant species habitats), with all necessary restoration measures completed on 15 % / 30 % of degraded areas by 2030, 40 % / 60 % by 2040 and 100% by 2050.
    - Sub-target: Re-wetting at least 25 % of HD Annex I peatland habitat area degraded due to drainage by 2030, 50 % by 2040 and 100 % by 2050 so that the water table is at, or with 15 cm of the surface.[6]
- Re-create the area necessary to achieve Favourable Conservation Status of HD Annex I peatlands[7] at national biogeographical level by 2050, with 15 % / 30 % achieved by 2030 and 40 % / 60 % by 2040, and 100 % achieved by 2050.

Marshlands

- Restore and re-create marshes as necessary to achieve the favourable conservation status of species that are listed in Annex II, IV and V of the Habitats Directive as well as all birds predominantly associated with marshes, with 15 % / 30 % of all necessary actions carried out by 2030 and 40 % / 60 % by 2040 and 100 % 2050.

1.4 Impacts of assessed target options

The costs of restoration of peatlands and inland marshes were estimated by calculating the area of degraded ecosystems to be restored and re-created annually to meet each target and applying average per hectare capital costs for restoration and re-creation, and annual costs for maintenance taken from Tucker et al (2013)[8]. The costs of restoration include the capital costs of restoration and re-creation actions such as ditch blocking, re-establishment of peat vegetation, removal of topsoil / reprofiling, scrub and tree clearance, fencing; and, annual maintenance costs, including monitoring and regulation of water levels, maintenance of sluices etc., integrated catchment management, mowing and removal of vegetation, and grazing management. The required management will be undertaken largely by private landowners and land managers, in return for incentive payments which include compensation for opportunity costs relating directly to land management (e.g. income forgone through reduced grazing). Maintenance costs were applied to the entire ecosystem area, since meeting the targets requires further degradation of ecosystems to be avoided.

Benefits estimates were based on an extensive review of literature on the value of benefits of peatland and marshland restoration, which identified changes in per hectare values of ecosystem services for restored vs degraded ecosystems. Median per hectare values were taken from per

[6] While this rewetting target is fully focused on the recovery of Annex I habitats, another rewetting target, on peatland under agricultural use, is assessed in the section on soils.

[7] According to Member States information on 'favourable reference areas' for their HD Annex I habitats, at least 3 000 km^2 would need to be re-created to achieve their FCS. However, the exact area required is uncertain as a significant proportion of Member States have not estimated favourable reference areas.

[8] Tucker et al., (2013) Estimation of the financing needs to implement Target 2 of the EU Biodiversity Strategy. Report to the European Commission. Institute for European Environmental Policy, London. Available at: https://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/Fin%20Target%202.pdf

hectare estimates given by 22 studies. This provided per hectare benefits estimates for peatlands (carbon storage and sequestration, total ecosystem service values) and marshlands/other inland wetlands (total ecosystem service values). Per hectare benefits estimates were applied to the area of ecosystem restored to give annual estimates of total benefits. Annual costs and benefits were estimated over the period 2022 -2070, recognising that, while restoration takes place to 2050, further maintenance costs continue beyond that date, while restored ecosystems continue to provide benefits into the future. Annual cost and benefit estimates were discounted, applying a 4% social discount rate, and summed to calculate their total present value. This enabled total net present value (benefits – costs) and benefit: cost ratios to be calculated.

Peatlands

The estimated costs of achieving good status of HD Annex I peatlands are summarised in Table I-2. The costs are broadly based on the area of habitat that is not in good condition or affected by specific pressures, multiplied by the costs of key measures to maintain the habitat, address the pressures and re-create habitat. The costs are additional to measures that are already in place (CAP measures) and do not include general supporting measures (e.g. creation of restoration plans), administration costs, or broad actions that apply to multiple ecosystems, such as the need to reduce nitrogen deposition below critical levels.

Table I-2: Summary of projected costs (EUR) of achieving restoration targets for HD Annex I peatlands in relation to current trends & expected 2030 baseline

NB Costs exclude Romania, due to missing reliable data on habitat extent.

Targets: 15-40-90 % [9]

Period	% Full restoration	Maintenance costs	Restoration costs	Re-creation costs	Combined costs	Total over period
Average annual costs						
2022-2030	15%	129 041 420	58 636 619	13 826 839	201 504 878	1 813 543 900
2031-2040	40%	130 134 987	87 954 929	20 740 258	238 830 174	2 388 301 743
2041-2050	90%	131 957 600	175 909 857	41 480 516	349 347 974	3 493 479 736
Cost over full period (29 years)						
2022-2050	90%	3 782 298 653	3 166 377 434	746 649 293	**7 695 325 379**	

Targets 30-60-90 %

[9] Although the 2050 target aims to restore 100 % of the habitat, the 2050 cost estimation is for 90 % restoration as this is the maximum percentage that can be expected in practice. Furthermore, an extrapolation of current restoration costs would no longer provide reliable estimates in the range between 90 and 100 %.

Period	% Full restoration	Maintenance costs	Restoration costs	Re-creation costs	Combined costs	Total over period
Average annual costs						
2022-2030	30%	129 041 420	117 273 238	27 653 678	273 968 336	2 465 715 021
2031-2040	60%	131 228 555	105 545 914	24 888 310	261 662 779	2 616 627 791
2041-2050	90%	133 415 690	105 545 914	24 888 310	263 849 914	2 638 499 141
Cost over full period (29 years)						
2022-2050	90%	3 807 815 228	3 166 377 434	746 649 293	**7 720 841 954**	

Marshlands

Table I-3 shows the projected costs of achieving 15 % / 40 % and 30 % / 60 % restoration targets, in relation to current trends and expected 2030 baseline data based on overall degradation extent and combined measures. Unlike for peatlands, due to inadequate data on degradation levels, this is based on an illustrative level of 50 % degradation. The required re-creation area of 558 km^2 is also illustrative, based on re-creating the area of marshlands lost since 1990.

Table I-3I: Summary of projected costs (EUR) of achieving restoration targets for marshlands in relation to illustrative degradation levels and re-creation requirements, and the costs of combined measures

Targets: 15-40-90 %

Period	% Full restoration	Maintenance costs	Restoration costs	Re-creation costs	Combined costs	Total over period
Average annual costs						
2022-2030	15%	156 954 750	7 812 268	367 350	165 134 368	1 486 209 308
2031-2040	40%	159 423 900	11 718 401	551 025	171 693 326	1 716 933 263
2041-2050	90%	163 539 150	23 436 803	1 102 050	188 078 003	1 880 780 025
Cost over full period (29 years)						
2022-2050	90%	4 642 223 250	421 862 445	19 836 900	**5 083 922 595**	

Targets 30-60-90 %

Period	% Full restoration	Maintenance costs	Restoration costs	Re-creation costs	Combined costs	Total over period
Average annual costs						

2022-2030	30%	156 954 750	15 624 535	734 700	173 313 985	1 559 825 865
2031-2040	60%	161 893 050	14 062 082	661 230	176 616 362	1 766 163 615
2041-2050	90%	166 831 350	14 062 082	661 230	181 554 662	1 815 546 615
Cost over full period (29 years)						
2022-2050	90%	4 699 836 750	421 862 445	19 836 900	**5 141 536 095**	

The main stakeholders affected by the targets are landowners and land managers (e.g. farmers), who would undertake the required restoration actions, in return for incentive payments funded by the taxpayer. The restoration works will create employment and income for land managers and contractors.

The restoration targets will deliver substantial benefits for biodiversity and a range of ecosystem services, most importantly carbon sequestration and storage, water quality improvements, flood risk management, erosion control and cultural services for both visitors and society at large. Peatland and marshland restoration will benefit the entire population and economy (through carbon and biodiversity benefits), as well as water companies and consumers, property owners, insurers and the tourism sector.

The ranges of per hectare values of benefits of restoration from the above studies are summarised in Table I-4. Studies estimating carbon sequestration and storage benefits of peatland restoration find estimated values ranging from €146 to 3,140 per hectare per year, with a median value of €287 per hectare per year. Studies estimating the value of two or more ecosystem services (typically including carbon, water, flood management, biodiversity and cultural services) find benefits estimates ranging from €164 to €4,895 per hectare per year, with a median value of €1,045 per hectare per year. Benefits of restoration of marshes (typically including flood alleviation, water quality improvements, carbon sequestration, biodiversity, recreation and other cultural services) range from €142-10 ,411 per hectare per year, with a median value of €1,258 per hectare per year.

Table I-4: Summary of Benefits Estimates from the restoration of inland wetlands

Ecosystem	Service valued	Range (EUR/ha/year)	Median estimate (EURO/ha/year)
Peatlands	Carbon storage	146 – 3,140	287
	Multiple ecosystem services	164 – 4,895	1,045
Marshes and other inland wetlands	All ecosystem services	412 – 10,411	1,258

The monetised **benefits** for carbon storage and sequestration from **peatland restoration** are estimated to outweigh the estimated costs of full ecosystem recovery (i.e. to good status). The benefit cost ratio ranges from 2.2 for the 15% 40% 90% targets to 2.5 for the 30% 60% 90% target. **If overall ecosystem service benefits are applied, the estimated net benefits increase markedly, with a benefit cost ratio of between 7.1 and 8.3.**

Table I-5: Benefits and costs of restoration of Annex 1 peatlands (Present value, 2022-2070, M EURO)

	15 % 40 % 90 % target	30 % 60 % 90 % target
Costs		
Maintenance	2 784	2 802
Restoration – full recovery	1 614	1 880
Re-creation	381	443
TOTAL (full recovery)	**4 779**	**5 125**
BENEFITS (full recovery)		
Carbon only	10 629	13 042
Total Ecosystem Services	38 702	47 488
Net Present Value (full recovery)		
Carbon only	5 850	7 917
Total Ecosystem Services	33 923	42 362
Benefit: Cost Ratio (full recovery)		
Carbon only	2.2	2.5
Total Ecosystem Services	7.1	8.3

For marshlands, benefit cost ratios for restoration are estimated at 1.8 - 2.1, depending on the target chosen.

Table I-6: Benefits and costs of restoration of marshlands (Present value, 2022-2070, M EUR)

	15 % 40 % 90 % target	30 % 60 % 90 % target
COSTS		
Maintenance	3 418	3 459
Restoration – full recovery	215	250
Re-creation	10	12
TOTAL (full recovery)	**3 643**	**3 721**
BENEFITS (full recovery)		
Carbon only	n/a (included in total ecosystem services)	n/a (included in total ecosystem services)

Total Ecosystem Services	6 388	7 838
Net Present Value (full recovery)		
Carbon only	n/a	n/a
Total Ecosystem Services	2 745	4 117
Benefit: Cost Ratio (full recovery)		
Carbon only	n/a	n/a
Total Ecosystem Services	1.8	2.1

1.5 Synthesis

Table I-7 provides a summary of the analysis of options and conclusions in relation to the effectiveness, efficiency, coherence, and proportionality of each target. The overall conclusion is that there are strong arguments for legally binding targets for achieving favourable conservation status of HD Annex I peatland habitats and of EU protected species associated with marshland. Whilst both targets slightly overlap, they also complement each other. Due to the exceptionally high importance and urgency to halt carbon losses, there is a strong argument to include a specific target for re-wetting drained peatlands used as cropland and productive grasslands and thereby extending and complementing the targets for Annex I restoration with a target for halting carbon losses from organic soils under agricultural use (see **soils** impact assessment where such a target is taken up and analysed in detail). While rewetting contributes to and is part of the restoration of Annex I habitats, a specific target for rewetting is not maintained here, but a target for rewetting drained peatland under agricultural use is proposed and analysed in the soil section.

Table I-7: Overview table assessing options on EU impact assessment criteria

	Habitats Directive Annex I peatlands	EU protected species of marshlands
Feasibility / effectiveness	High feasibility and potential for restoration. Re-creation is limited to areas retaining deep peat soils. Effective in maintaining carbon stores, and with time recovery of vegetation, carbon sequestration and several other ecosystem services.	High feasibility and potential for restoration. Re-creation may be limited by the availability of water and suitable sites. Restoration is highly effective for biodiversity and contributes to several other ecosystem services.
Efficiency	Strong evidence of benefits of restoration for biodiversity and ecosystem services, including climate mitigation. Available valuation evidence suggests carbon benefits alone exceed restoration costs; inclusion of wider ecosystem service values gives high estimated benefit: cost ratios.	Restoration of marshlands benefits biodiversity and a range of ecosystem services. Benefits estimated to outweigh costs for inland marshes restoration targets by a factor of 2:1.
Coherence	Full coherence with EU environmental policies and climate goals. Potential to make substantial contributions to climate mitigation, and significant contributions to climate adaptation.	Full coherence with EU environmental policies and climate goals. Potential to make substantial contributions to climate adaptation and some contribution to mitigation.

Proportionality	Proportionate to the very high importance of the habitats for biodiversity and associated ecosystem services	Proportionate to the high importance of the habitats for biodiversity and associated ecosystem services.
Conclusions	**Include in targets with very high priority, including with target to halt carbon losses through re-wetting.**	**Include with high priority.**

2. Coastal and other saline wetlands

2.1 Scope

In the MAES framework, coastal wetlands are defined as "marine" and "marine inlets and transitional waters" ecosystem types. The latter are considered as "ecosystems on the land-water interface under the influence of tides and with salinity higher than 0.5% which, beside coastal wetlands, also include 'lagoons, estuaries and other transitional waters, fjords and sea lochs as well as embayments'. The study defined coastal wetland habitats in more detail by using habitat types as defined in Annex I of the Habitats Directive (HD Annex I habitats), but excluding the HD Annex I habitat type 'Large shallow inlets and bays' which is considered in the marine ecosystems thematic impact assessment (IA), and including four HD Annex I habitat types not considered as coastal wetlands under the MAES typology. Two are Mediterranean coastal habitat types on wet soils dependent on marine saline influences, and two are inland habitat types dependent on saline conditions caused by high evaporation of mineral-rich groundwater. Moreover, only the intertidal EUNIS habitats of the HD habitat types of estuaries, mud-and sandflats and coastal lagoons were included, while others were left to the marine IA. Based on EU Member States' estimates, the total area of the 11 HD Annex I habitat types is 37 780 km^2, of which the tidal habitats cover 83 %.

Detailed data on the geographical distribution, area (km^2), conservation status and condition of coastal and other saline wetland habitat types of Annex I of the Habitats Directive in EU Member States is provided in Annex VIII-a.

2.2 Problem, current trends and ecosystem-specific baseline

Coastal wetlands have remained relatively stable in terms of area coverage in the EU-28 between 2000 and 2018 with a slight increase of 0.2 % according to CORINE land cover. Yet, status reporting under the Habitats Directive according to Article 17 found that only 5% of the Annex I habitat assessments showed good status, and 82% a poor or bad status. In addition, only 11% of the coastal wetlands' assessments deemed unfavourable is showing signs of improvement, while more than 36% are further deteriorating. While there have been several efforts to improve the status of these habitat types, the EU Ecosystem Assessment in 2020[10] showed that tangible improvements are far from being achieved. Based on Habitats Directive data, a best estimate on total area to be restored would amount to **45 % or 16727,33 km^2**.

Coastal wetland restoration directly and indirectly serves the political and policy objectives of the European Union due to their vast ecosystem services. Coastal wetlands also offer unique habitat conditions for threatened species, especially bird species protected under the EU Birds Directive. Despite representing a comparatively small area among all wetland habitats, coastal wetlands provide significant carbon sequestration services, thus acting as a critical carbon sink for the Union, which seeks to cut carbon emissions by 55% by 2030. Further, as our communities become increasingly urban and coastal, some projections estimate that by 2060, 55.7 million people in Europe will live in low-elevation coastal zones[11]. As coastal storms become more unpredictable and violent, the more we will need coastal wetlands to serve as protective barriers. Therefore, the

[10] Maes et al. (2020). Mapping and Assessment of Ecosystems and their Services: An EU ecosystem assessment
[11] Neumann et al. (2015) Future coastal population growth and exposure to sea-level rise and coastal flooding--a global assessment.

ecosystem services provided by coastal wetlands are not only important to successfully realise a myriad of EU environmental policy objectives, but also to human security.

Without additional efforts, the rate of degradation of coastal- and inland saline ecosystems will continue to worsen as the effects of climate change, tourism development, and the coastal squeeze effect worsen with time and an increasing population in coastal communities. Amongst the wide range of threats that coastal wetlands face, the IA identified the following as the highest pressures impacting these groups of habitats: changing agricultural practices (e.g. overgrazing or abandonment of grassland management), construction and use of residential, commercial, industrial, and recreational infrastructure, invasive alien species, pollution, and extraction and cultivation of biological living resources (e.g. shell-fishing). It is worth noting that these pressures and threats differ considerably between habitat types in scope of this assessment. Furthermore, intensifying effects of climate change towards 2030, 2040 and 2050 will accelerate sea level rise and related coastal erosion. While this would normally simply transgress coastal wetlands further inland, in most EU coasts protected by flood defence networks it will result in a loss of coastal habitats. In the first phases of restoration action, particular attention shall therefore be given to wetlands which have suffered from the '*coastal squeeze effect'*, which describes the combined pressure of sea-level rise and urban development along the coast, which leaves little to no room for coastal wetlands to retreat.

Since many of the challenges to restore coastal wetlands are transboundary in nature, EU cooperation can help address them: For example, the agricultural-related pressures and threats can be mitigated by an increase in efforts towards restoration in policies such as the Common Agricultural Policy.

2.3 Target options screened in/out

Restoration actions can take various forms and depend not only on the ecological ambitions but also the socio-economic context under which the restoration action is taking place. Restoration actions can be classified into different measures that are ultimately dependent on the needs of the habitat but also the scale of restoration needed. Actions for coastal wetland habitats that are degraded could include the following:

- Add sediment to raise land above the water level and allow wetland plants to colonize
- Re-wetting of drained coastal wetlands
- Removing/bypassing anthropogenic barriers to restore hydrological connectivity
- Transplantation of vegetation to assist in re-vegetation
- Removal of invasive alien species
- Improved agricultural management of meadow and marshland habitats

In terms of restoring, re-creating, and maintaining coastal wetlands to/in a good condition, the first step will usually require re-wetting and resedimenting wetlands which have suffered from the 'coastal squeeze effect'. These type of restoration measures have been successfully implemented in the EU through so-called LIFE projects, which co-fund and assist member states, in restoration projects. Based on these restoration actions and the baseline and trends of pressures, there are four possible options to target setting that we have identified and screened for their effectiveness, relevance, coherence, and proportionality (Table II-1).

Table II-1 Summary table screened target options

Target option	Screened in/out for assessment	Key reason(s) for screening in/out
Option 1: HD Annex I restoration target	Screened in	• The feasibility of this option should be high, as it builds on an existing legal framework which includes a detailed monitoring and reporting system. • Coastal wetland restoration in the framework of the HD has demonstrated effectiveness where it took place. • The option would be proportional in scope, as it would focus primarily on habitats of EU interest from a biodiversity perspective, the restoration of which is already a long-standing and widely accepted need recognized in EU policy.
Option 2: Nature Directives coastal species target	Screened in	• Like the HD Annex I option, such a species target would be based on an existing implementation framework with monitoring and reporting requirements. However, it would need to assess progress based on a much bigger body of data, as there are many more listed species than habitats and their restoration needs are more diverging. • The target could be very effective if implemented with adequate resources to follow-up on individual species • the option would be proportional in scope, as it would focus primarily on species habitats of EU interest from a biodiversity perspective.
Option 3: Salt marsh re-creation target	Screened out	• There is available data in percentage terms of degraded and lost salt marshes; however as not all salt marshes are HD Annex I habitat types, it would require an additional monitoring and reporting requirement. • However, since a very large share of salt marshes is Annex I habitat and inside Natura 2000, they would likely sufficiently benefit from an Annex I habitat restoration target Option 1 while not excluding other habitat types.
Option 4: Bottom-disturbing (shell-) fishing phase out target in Natura 2000 sites	Screened out	• As commercial fishing in Natura 2000 sites is usually subject to permitting, there should be both data available as well as a legal means to gradually phase out the most harmful fishing/harvesting techniques applied in coastal wetlands. Legally it would correspond to objectives under the EU Nature Directives, MSFD and Common Fisheries Policy. • The option would be limited in scope, as it would only target a single pressure and only a share of coastal wetland habitat. The proportionality of such a target at EU level would likely be questioned on subsidiarity grounds.

The following three targets were selected for more detailed impact assessment. The targets are all connected to one another, and are sub-targets of options 1 and 2 above:

- Target 1a: Restore all HD Annex I coastal- and inland saline wetland habitat area to good condition, with all necessary restoration measures completed on 30 % (or 15 %) of degraded areas by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
- Target 1b: Recreate 30 % (or 15 %) of additional habitat area required to achieve FCS of HD Annex I coastal- and inland saline wetland habitats by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
- Target 1c: Restore and re-create coastal- and inland saline wetland habitats as necessary to achieve the favourable conservation status of species that are listed in Annex II, IV and V of the Habitats Directive and all birds predominantly associated with coastal- and inland saline wetland ecosystems, with 15 % of all necessary actions carried out by 2030 and 40 % by 2040 and 100 % 2050.

2.4 Impacts of assessed target options

The costs of restoration of coastal wetlands were estimated by calculating the area of degraded ecosystems to be restored and re-created annually to meet each target and applying average per hectare capital costs for restoration and re-creation, and annual costs for maintenance taken from Tucker et al.[12] The costs of restoration include the capital costs of restoration actions such as revegetation and rewetting works, removal of alien species, and creation of wetlands to treat agricultural water pollution, as well as restrictions on fishing. The costs of re-creation include managed realignment, works to reclaim land through sedimentation, and introduction of appropriate grazing. Annual maintenance costs include appropriate grazing management, regulation of water levels and re-sedimentation. The required management will be undertaken largely by private landowners and land managers, in return for incentive payments which include compensation for opportunity costs relating to management of land and fisheries (e.g. income forgone through re-creation of coastal wetlands on agricultural land, restrictions on fishing effort). Maintenance costs were applied to the entire ecosystem area, since meeting the targets requires further degradation of ecosystems to be avoided.

Benefits estimates were based on an extensive review of literature of the value of benefits of coastal wetlands and their restoration, which identified changes in per hectare values of ecosystem services for restored vs degraded ecosystems. Median per hectare values were taken from per hectare estimates given by 13 studies. This provided per hectare benefits estimates for carbon storage and sequestration, and for total ecosystem service values. Per hectare benefits estimates were applied to the area of ecosystem restored to give annual estimates of total benefits. Annual costs and benefits were estimated over the period 2022 -2070, recognising that, while restoration takes place to 2050, further maintenance costs continue beyond that date, while restored ecosystems continue to provide benefits into the future. Annual cost and benefit estimates were discounted, applying a 4% social discount rate, and summed to calculate their total present value. This enabled total net present value (benefits – costs) and benefit: cost ratios to be calculated.

[12] Tucker et al., (2013) Estimation of the financing needs to implement Target 2 of the EU Biodiversity Strategy. Report to the European Commission. Institute for European Environmental Policy, London. Available at: https://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/Fin%20Target%202.pdf

Those that would be responsible for implementing regulations that help restore and recover coastal wetlands are primarily government actors. Wetlands in Europe are managed at different governmental levels depending on their organisational structure. In Germany, for instance, coastal wetlands are managed by the environmental ministries of the *Länder* (regional governments), whereas in other countries, wetlands are managed on a federal level. Nevertheless, the planning, financing and implementation of coastal wetlands restoration involves a plethora of different actors across Europe, regardless of how and by whom coastal wetlands are legally managed. Actors such as local banks and private companies (e.g. in tourism), nature site managers, research institutions and civil society have all, to varying degrees, been consulted, and sought for involvement in coastal wetland restoration in several EU LIFE projects. This multi-actor involvement is crucial to ensure that restoration projects are well understood by all actors concerned by the marsh, either directly or indirectly, and that these projects can receive funding from as many sources as possible. These mutually beneficial, public-private-partnerships can help stemming the funding challenges for saltmarsh restoration projects and motivate the private sector to ensure their success.

The stakeholders impacted the most by coastal wetland restoration and re-creation are those that depend on these ecosystems for their economic livelihoods. As previously outlined, coastal ecosystems provide vital services for agriculture and fisheries. Those working directly and indirectly in the fisheries industry may be impacted by coastal wetland restrictions, but on the longer term may benefit from higher and more resilient catches as habitat for commercially important (shell-)fish species recover. Farmers may be impacted by coastal wetland regulations, such as those that limit the amount of nutrient run-off and pollution from entering protected coastal wetland. Similarly, the tourism industry is heavily concerned by wetland restoration as these ecosystems are primary targets of a variety of touristic activities. This is compounded by the significant threat that tourism places on coastal wetlands in terms of grey infrastructure and pollution.

The total cost of all regenerative coastal wetland activities falls within the range of € 5.1billion to € 5.9 billion (present value of total costs to 2070). While these costs may be high given the relatively small area of coastal wetlands, they are comparatively low to the benefits that these ecosystems provide in terms of their total ecosystem services. Services such as storm surge mitigation, protection against coastal erosion, water filtration, fish stock restoration, biodiversity, recreation and other cultural services, are valued between € 182 billion and € 223 billion (present value of benefits flows to 2070).

The analysis estimates that the monetized benefits for carbon storage and sequestration amount to approximately 20% of the estimated costs of full ecosystem recovery (i.e. to good condition). However, if overall ecosystem service benefits are applied, the estimated net benefits increase markedly, with a benefit cost ratio of between 35 and 38. This reflects the large value of regulating, cultural and provisioning services of restored cultural wetlands, with carbon values accounting for only a small proportion of total service values. Some caution is needed in interpreting these figures, which are based on median benefits values. The source studies give a very wide range of benefits estimates, and the median values applied, while very conservative compared to the upper range estimates found in the review, exceed the lower bound estimates found by some studies.

Table II-2: Summary of projected costs (EUR) of achieving restoration targets for HD Annex I coastal wetlands in relation to current trends & expected 2030 baseline based on overall degradation extent and combined measures

Targets: 15-40-90 %[13]

Period	% Full restoration	Maintenance costs	Restoration costs	Re-creation costs	Combined costs	Total over period
Average annual costs						
2022-2030	15 %	38 193 020	154 114 338	3 015 598	195 322 956	1 757 906 601
2031-2040	40 %	38 193 020	231 171 507	4 523 397	273 887 924	2 738 879 236
2041-2050	90 %[14]	38 193 020	462 343 014	9 046 793	509 582 827	5 095 828 273
Cost over full period (29 years)						
2022-2050	90 %	1 107 597 577	8 322 174 259	162 842 274	**9 592 614 110**	

Targets: 30-60-90 %

Period	% Full restoration	Maintenance costs	Restoration costs	Re-creation costs	Combined costs	Total over period
Average annual costs						
2022-2030	30 %	38 193 020	308 228 676	6 031 195	352 452 891	3 172 076 023
2031-2040	60 %	38 193 020	277 405 809	5 428 076	321 026 904	3 210 269 043
2041-2050	90 %[15]	38 193 020	277 405 809	5 428 076	321 026 904	3 210 269 043
Cost over full period (29 years)						
2022-2050	90 %	1 107 597 577	8 322 174 259	162 842 274	**9 592 614 110**	

Table II-3: Summary of Benefits Estimates from Ecosystem Restoration

Ecosystem	Service valued	Range (EUR/ha/year)	Median estimate (EURO/ha/year)

[13] Although the 2050 target aims to restore 100 % of the habitat, the 2050 cost estimation is for 90 % restoration as this is the maximum percentage that can be expected in practice. Furthermore, an extrapolation of current restoration costs would no longer provide reliable estimates in the range between 90 and 100 %.

[14] Although the 2050 target aims to restore 100 % of the habitat, the 2050 cost estimation is for 90 % restoration as this is the maximum percentage that can be expected in practice. Furthermore, an extrapolation of current restoration costs would no longer provide reliable estimates in the range between 90 and 100 %. (See methodology section in SWD)

[15] Although the 2050 target aims to restore 100 % of the habitat, the 2050 cost estimation is for 90 % restoration as this is the maximum percentage that can be expected in practice. Furthermore, an extrapolation of current restoration costs would no longer provide reliable estimates in the range between 90 and 100 %. (See methodology section in SWD)

Coastal Wetland	Carbon storage	-	74
	Multiple ecosystem services	909-89 000	12 318

Table II-4: Cost-benefit ratio table for the HD Annex I habitat restoration + re-creation target (1a+ 1b) for 2 different scenarios of restoring 15-40-90 % or 30-60-90 % of coastal wetland area by 2030-40-50 (in present value, million EUR)

	15 % 40 % 90 % target	30 % 60 % 90 % target
COSTS		
Maintenance	815	815
Restoration – full recovery	4 243	4 941
Re-creation	83	97
TOTAL (full recovery)	**5 141**	**5 852**
BENEFITS (full recovery)		
Carbon only	1 091	1 339
Total Ecosystem Services	181 614	222 842
Net Present Value (full recovery)		
Carbon only	-4 050	-4 514
Total Ecosystem Services	176 473	216 990
Benefit: Cost Ratio (full recovery)		
Carbon only	0,2	0,2
Total Ecosystem Services	35,3	38,1

2.5 Synthesis

The analysis demonstrated the urgency of coastal wetland restoration in the face of growing anthropogenic pressures including climate-change driven sea-level rise and related coastal squeeze. Despite the limited time available for an in-depth review, the analysis uncovered a wealth of evidence on successful past coastal restoration project as well as studies on its costs and benefits. The urgency of action required in combination with the large benefits for biodiversity and climate change mitigation and adaptation -the two core objectives of the legally binding initiative- make coastal wetlands a priority ecosystem for short-term action. Table II-5 provides an overview of the key findings of assessing the three screened-in targets against the five key IA criteria. In short, the assessment found that all three targets have a high feasibility and potential to help meet the initiative's primary objectives, would be fully coherent with EU nature- as well as climate mitigation adaptation policies and proportional to the urgency of action required on them, would help increase the efficiency of implementing existing policy commitments and/or legal requirements and would do so against very favourable cost-benefit ratios. As a result, the IA study recommends prioritising all three target options in a legal proposal, with a particularly high priority for the habitat restoration- and re-creation targets.

Table II-5: Overview table assessing options on EU impact assessment criteria

	Habitats Directive Annex I coastal wetlands restoration	**Habitats Directive I coastal wetlands re-creation**	**EU protected species of coastal wetlands**
Feasibility / effectiveness	High feasibility and potential for restoration. Restoration is highly effective for biodiversity, other ecosystem services, and can also contribute to human security and bring other socio-economic benefits.	High feasibility and potential for re-creation of habitats, although feasibility is slightly lower than for Target 1 as there will be impacts on the users of the land to be used for the re-creation project. Re-creation would bring similar benefits than Target 1.	High feasibility and potential for restoration, with this Target combining Targets 1 and 2.
Efficiency	Strong evidence of benefits of restoration for biodiversity and ecosystem services, including climate mitigation. Benefits have shown to significantly outweigh costs by a factor of 30.	Strong evidence of benefits of habitat re-creation for biodiversity and ecosystem services, including climate mitigation. Habitat recreation is a relatively low cost, given that the costs are fixed and not recurring, with significantly higher benefits.	Strong evidence of benefits of habitat restoration and re-creation for biodiversity and ecosystem services, including climate mitigation. Benefits have shown to significantly outweigh costs, although this option would entail the highest costs.
Coherence	Full coherence with EU environmental policies as this option builds on existing legislation (i.e. the HD). Important benefits for other EU objectives such as on water- and flood risk management are also expected.	Full coherence with EU environmental policies as this option builds on existing legislation (i.e. the HD). Benefits for other EU objectives such as on water- and flood risk management are also expected.	Full coherence with EU environmental policies as this option builds on existing legislation (i.e. the HD and BD). Benefits for other EU objectives such as on water- and flood risk management are also expected.
Proportionality	Proportionate to the very high importance of the good status of habitats for biodiversity and associated ecosystem services.	Habitat re-creation is necessary to achieve the favourable conservation status of some HD Annex I habitats, and to enable to the recovery of some threatened coastal wetland habitats.	Proportionate to the high importance of the habitats for biodiversity.
Conclusion	**Include with very high priority.**	**Include with very high priority.**	**Include with high priority.**

3. Forests

3.1 Scope

Woodland and forest ecosystems according to the EU MAES typology[16] are areas dominated by woody vegetation of various age or they have succession climax vegetation types on most of the area supporting many ecosystem services. Under the EUNIS typology[17], ‘G: Woodland, forest and other wooded land’ include the following four broad habitat types each of which contain a large number and diversity of sub-habitat types:

- T1: Broadleaved deciduous forest
- T2: Broadleaved evergreen forest
- T3: Coniferous forest
- T4: Lines of trees, small anthropogenic forests, recently felled forest, early-stage forest and coppice

This diversity is also reflected in the 80 different forest habitat types included in Annex I of the Habitats Directive (out of 233 in total, or 34 %). Out of these 80 habitat types, 69 were included in the scope of this mini-Impact Assessment (IA) and include the following broad habitat types:

- Boreal forests (6 types)
- Temperate forests (32 types)
- Mediterranean and Macaronesian forests (18 types)
- Mountainous coniferous forests (13 types)

Alluvial forests (8 types) and wooded meadows (3 types) were excluded from this mini-IA and instead included in separate mini-ecosystem assessments on rivers & lakes ecosystems and agro-ecosystems respectively. Forests are the largest terrestrial ecosystem type in the EU-27 and in 2018 covered 1 770 997 km^2 or 39% of the EU27 land area following the EUNIS-based approach taken for the European Ecosystem Map[18].

In addition, actions are considered for forest areas beyond those covered by the Annex I habitats types under the Habitats Directive; see section 3.6.

Detailed data on the geographical distribution, area (km^2), conservation status and condition of forest habitat types of Annex I of the Habitats Directive in EU Member States is provided in Annex VIII-b.

[16] Maes J. et al (2013) Mapping and Assessment of Ecosystems and their Services. An analytical framework for ecosystem assessments under action 5 of the EU biodiversity strategy to 2020. Publications office of the European Union, Luxembourg. Available at: https://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/pdf/MAESWorkingPaper2013.pdf

[17] The European nature information system or EUNIS habitat classification is a comprehensive pan-European system for habitat identification. The classification is hierarchical and covers all types of habitats from natural to artificial, from terrestrial to freshwater and marine. The habitat types are identified by specific codes, names and descriptions. The full EINIS https://eunis.eea.europa.eu/habitats-code-browser.jsp

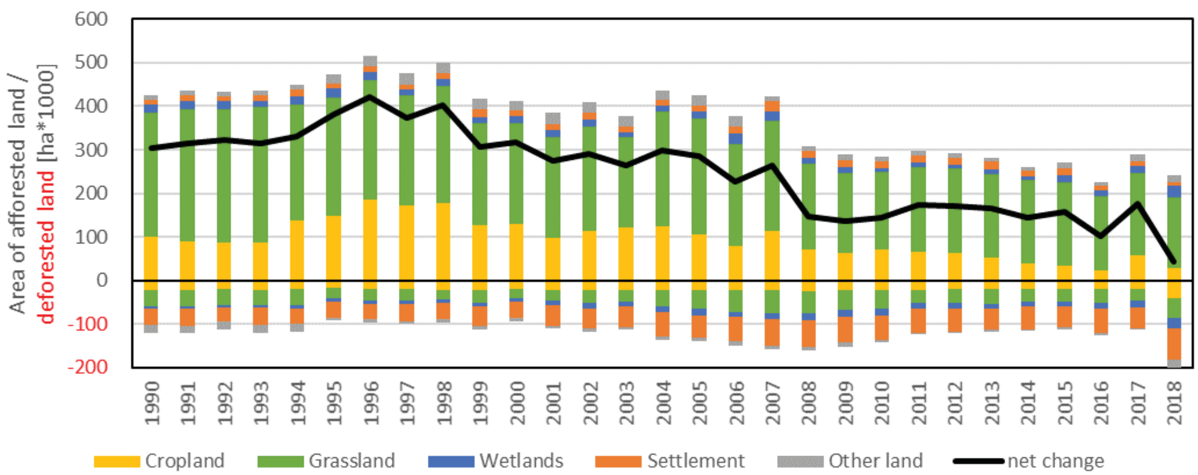
[18] EEA (2020) Mapping Europe's ecosystems. Available at: https://www.eea.europa.eu/themes/biodiversity/mapping-europes-ecosystems/mapping-europes-ecosystems

Problem, current trends and ecosystem-specific baseline

As the largest terrestrial ecosystem type in the EU, forests are of vital importance for biodiversity, and ecosystem services including climate change mitigation and adaptation.

Forest cover in Europe has been relatively stable since 2000 according to Corine Land Cover mapping. The total area had increased by 1 807 km^2 between 2000 and 2018. Despite this apparent stability, within each time period there was reasonable amounts of turnover in extent with approximately equal amounts of forest cover loss and forest cover gain. In addition, the annual natural expansion of forests and net area of land converted to forest by man are both falling in the EU, suggesting a change in trend towards future reductions in extent (Figure 1).

Figure III-1 Area of annually afforested land / deforested land in the EU27 for the period 1990-2018. Source: EU Member States' GHG inventory submission of 2020).



Over the last centuries, most of Europe's natural forests have been replaced by managed forests. Most of the EU's forests are semi-natural (93 %) and are available for wood supply (FAWS). Currently, more than 70 % of the FAWS is even aged, and almost 30 % un-even aged. 30 % have only one tree species (mainly conifers), 51 % have only two to three tree species, and only 5 % of forests have six or more tree species.[19]

Although no major net change in forest cover area in the EU has been observed in recent decades, and certain structural condition indicators have improved (e.g. biomass volume and deadwood), in general the condition of EU forests is considered poor.[20] Several indicators point to a degrading trend, for example one out of four trees show defoliation levels indicating compromised condition. Also the amount of deadwood is below the desirable threshold levels for biodiversity in various forest habitat types which has been estimated to be at least 20-50

[19] Forest Europe (2020) State of Europe's Forests 2020. Available at: https://foresteurope.org/state-europes-forests-2020/

[20] Maes, J. et al (2020) Mapping and Assessment of Ecosystems and their Services: An EU ecosystem assessment. Available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC120383.

m3/ha for most central European forests[21], and 43 % of forests in the EU is affected by pressures from Invasive Alien Species.

Evidence from reporting under the Habitats Directive (HD) reveals the deteriorating condition of EU's forests: The vast majority (84 %) of the assessments of 69 forest habitats in scope of this mini-IA have an unfavourable conservation status (of which 58 % poor and 26 % bad). Only 16 % have a good conservation status. Among the habitat assessments that do not have a good status, under one-fifth have a deteriorating trend (17 %) while 18 % have an improving trend.

Regarding species associated to forest habitats, if populations of common forest bird species remained relatively stable[22] several species, in particular, species relying on mature forests and dead wood are under pressure. In Sweden, 69 % of the red-listed forest insects are saproxylic species; on the other hand, more than 20 % of long-horned beetle species have declined in abundance since the 1950s and 10 % have become extinct in the last 200 years, linked to the development of intensive industrial forestry[23]. In Finland, at least 2 % of the national fauna has been driven to extinction since 1800, 20 % of saproxylic beetles are currently red-listed, and the reduction of dead wood in forests is considered the dominant threat to 34 % of these listed species.[24] In France[25] and Germany[26], the proportion of rare or threatened saproxylic beetles reaches 35 %. The European Red List assessment of 653 of the best known saproxylic beetle species reports 17 % endangered or vulnerable species.[27]

Forests provide a wide range of ecosystem services, including timber provisions, non-wood goods, carbon sequestration, flood control, water purification and nature-based recreation. Combined, these forest services are estimated at a total economic value €81 413 million (EU28, 2012), wood production representing 18 %. Forestry and logging employs almost 500 000 people in the EU27 and the wider sector around 4,5 million people (EU28). Forests currently sequester around 10 % of the EU's annual emissions. While the EU forest sink is currently declining, there is a vast potential to enhance this forest function for climate change mitigation. Forests are considered to play an increasing role to the EU's climate targets for 2030 and 2050. Further degradation of EU forests undermines their capacity to sustain biodiversity and provide ecosystem services.

Forest pressures indicators can be categorised in: (i) habitat conversion and degradation; (ii) climate change; (iii) pollution and nutrient enrichment; (iv) overharvesting; (v) introduction of invasive alien species; and (vi) other pressures such as pests, parasites, insect infestations and soil

[21] Müller, J. & Bütler, R. (2010) A review of habitat thresholds for dead wood: A baseline for management recommendations in European forests. European Journal of Forest Research. 129. 981-992. 10.1007/s10342-010-0400-5. Available at: https://www.researchgate.net/publication/226995213_A_review_of_habitat_thresholds_for_dead_wood_A_baseline_for_management_recommendations_in_European_forests.

[22] Maes, J. et al (2020) Mapping and Assessment of Ecosystems and their Services: An EU ecosystem assessment. Available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC120383.

[23] Lindhe (2010) Longhorn beetles in Sweden - changes in distribution and abundance over the last two hundred years. Available at: https://www.researchgate.net/publication/220000768_Longhorn_beetles_in_Sweden_-_changes_in_distribution_and_abundance_over_the_last_two_hundred_years

[24] Martikainen (2013) Saproxylic beetles in boreal forests: temporal variability and representativeness of samples in beetle inventories. Pp 83-86 in: F. Mason, G. Nardi & M. Tisato (eds). Proceedings of the International Symposium ''Dead wood, a key to biodiversity''Mantova, Italy, May 29th-31st 2003, Sherwood 95.

[25] Bouget et al., (2019). Les Coléoptères saproxyliques de France: Catalogue écologique illustré.

[26] Totholzkäfer in Naturwaldzellen des noerdlichen Rheinlandes. Vergleichende Studies zur Totholzkäferfauna Deutschlands und deutschen Naturwaldforschung. Landesamt für Agrarordnung NordRheinWestfalen.

[27] Cálix et al (2018) European Red List of Saproxylic Beetles. Brussels, Belgium: IUCN. Available at: https://portals.iucn.org/library/node/47296

erosion.[28] Table III-1 shows an overview of these pressure categories and indicators. Climate change and human activities are found to be the most severe causes of the pressures identified on forest habitats and species. Article 17 of the HD states that Forest habitats are subject to a wide diversity of pressures resulting in their degradation and extirpation. According to Member States reports under Article 17 of the HD, the top three groups of pressures (in percentage of the total) are:

- Habitat management with close to 61 % of all pressures; these include inadequate forestry practices like removal of dead and old trees (30 %), clearcutting (10 %), reduction of old growth forest (8 %);
- Conversion and land use change amounts to 13 %; from these, 45 % correspond to conversion to other forest types (including monocultures), 22 % to construction of urban, commercial, industrial and leisure areas, and 12 % to transport infrastructure;
- Natural processes, with about 8 %; this is mainly due to interspecific relations (competition, parasitism and pathogens) (43 %) and changes in species composition (34 %).

Equally important is alien and problematic species with over 7 %, mainly invasive alien species (58 %), and plant diseases, pathogens, and pests (26 %).

On balance it seems likely that pressures on forests will continue to grow, primarily as a result of forest management and accelerating climate change. Continuous pressures are expected to negatively affect various ecosystem services that forests provide, including wood production, biodiversity protection as well as the role forest have for climate change mitigation. Forests' ability to sequester carbon from the atmosphere is projected to decline further towards 2030 and beyond, under a baseline scenario. A policy analysis (covering the BHD, the CAP, the revision of the LULUCF Regulation and the Carbon Farming Initiative) suggests that even considering ongoing policy reviews and new initiatives, in the absence of additional action to establish legally binding targets, there will likely be a continuous *policy gap* to adequately address the need to restore forest ecosystems and protect them from further deterioration.

Table III-1 Pressure categories and indicators

Pressure category	Indicators
Forest management	• Inadequate forestry practices (e.g. excessive removal deadwood / old trees) • Clear-felling • Harvesting intensity (ratio annual fellings to annual increment) • Absence of the terminal and decline phases (natural silvigenetic cycle) • Reducing of old growth forests • Drainage of peatland forest and wet forests • Simplification of the composition of the dendrological composition
Conversion and Land Use Change (LUC)	• Forest cover change (e.g. semi-natural forests > monoculture plantation of one-age class) • Forest land take • Tree cover loss • Forest fragmentation
Climate change	• Extreme Droughts • Fires (scale, frequency) • Effective rainfall • Mean annual temperature • Soil moisture • Tree mortality

[28] Maes et al (2020) Mapping and Assessment of Ecosystems and their Services: An EU ecosystem assessment. Available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC120383.

	• Storms • Droughts and heat induced tree mortality • Effect of droughts on forest productivity
Pollution and nutrient enrichment	• Tropospheric ozone (AOT40) • Exceedances of critical loads for acidification • Exceedances of critical loads for eutrophication
Invasive Alien Species	• Pressure by invasive alien species
Other pressures	• Diseases, • Pathogens • Pests • Parasites • Insect infestations • Soil erosion • Changes in species composition

Target options screened in/out

A comprehensive approach to preserve and restore the diversity of an ecosystem must consider its structural, compositional, and functional characteristics. The favourable conservation status of forest habitats at local level is often characterized by different parameters as such habitat extent, parcelling and fragmentation, trees species composition's integrity (dendrological integrity and absence of invasive species), forest dynamics (number of large living trees, living trees with microhabitats and renewal process), vertical vegetation structure that allows the multiplication of habitats for a wide diversity of species, the matter cycle (volume of dead wood) and absence of deterioration (e.g. soil damage - compaction, hydrological disturbances, etc.).

The main forest biodiversity issues include elements (species, populations) that are found only in forests or that are particularly sensitive to management, or that are threatened. Moreover, composition of forest species and the genetic diversity of populations of a given species are largely determined by the management practiced; animal species sensitive to disturbance, fauna and flora of the soil sensitive to compaction, threatened taxa (as defined by IUCN), rare species or populations and species or populations whose abundance is declining.

Options for targets are:

Table III-2 Summary table screened target options

Target option	Screened in/out for assessment	Key reason(s) for screening in/out

Option 1a: Target to restore all HD Annex I forest area to good condition, with all necessary restoration measures completed on 15 % of degraded areas by 2030, 40 % by 2040 and 90 % by 2050 and recreate 15 % of additional habitat area required to achieve Favourable Conservation Status (FCS) of HD Annex I forest habitats by 2030, 40 % by 2040 and 100 % by 2050.	In	This option targets the restoration of Annex I forests habitat area and could help enhance biodiversity in these forests, as well their ecosystem services, including for climate change mitigation and adaptation. This target is based on already established indicators and reporting under Habitats Directive Article 17 and while some data gaps remain, availability of data is largely sufficient to support a target. Reporting would be integrated in existing reporting flows. Complementary reporting on measures taken by Member States to implement the target would be necessary. There are no immediate legal or political barriers for this option while there is a strong coherence with existing EU policies and policy objectives. This option would cover only forest habitats under Annex I of the HD and would therefore be limited in its effectiveness to gradually restore all forest ecosystems in the EU.
Option 1b: Target to restore all HD Annex I forest area to good condition, with all necessary restoration measures completed on 30 % of degraded areas by 2030, 60 % by 2040 and 90 % by 2050 and recreate 30 % of additional habitat area as required to achieve Favourable Conservation Status (FCS) of Annex I forest habitats by 2030, 60 % by 2040 and 100 % by 2050.	In	Idem as above but with a different timeline / trajectory.
Option 2: Restore and re-create forest habitats as necessary to achieve the favourable conservation status of wild birds and species that are listed in Annex II, IV and V of the Habitats Directive and predominantly associated with forests, with 30 % (or 15 %) of all necessary actions carried out by 2030 and 60 % (or 40 %) by 2040 and 100 % by 2050.	In	This option provides a target for improving the condition status of certain species. Many species depend on forests, and this option is based on the assumption that efforts to improve their status will involve the restoration of forests habitat area, which will, in turn, also result in the improvement of other forest-associated species. Improving the condition of species listed in Annex II, IV and V of the Habitats Directive as well as wild birds' species is already a legal objective under the BHD and a target would add a deadline for action to deliver a contribution towards that objective. This target is based on already established indicators and reporting under Habitats Directive Article 17 and Birds Directive Article 12 and while some data gaps remain, availability of data is largely sufficient to support a target. Reporting would be integrated in existing reporting flows. Complementary reporting on measures taken by Member States to implement the target might be necessary. There are no immediate legal or political barriers for this option while there is a strong coherence with existing EU policies and policy objectives. This target does not exclusively address Annex I forest habitat areas, so this option could complement option 1.
Option 3a: Restore degraded non-Annex I habitats forest area to a good condition, with all necessary restoration measures completed on 15 % of degraded areas by 2030, 40 % by 2040 and 100 % by 2050.	In	This target would have a wide scope, covering 72 % of the EU forest area. Assessments suggest that there is a significant potential to restore non-Annex I forests and improve the condition of biodiversity, and ecosystem services including climate mitigation and adaptation. However, there is currently no systemic EU-wide methodology for assessing ecosystems condition nor a definition of "good ecosystem condition" for non-Annex I forests habitats. Furthermore, there is no reporting mechanism on the ecological condition or status for forest ecosystems outside of the scope of the HD Annex I. Consequently, this option would involve establishing a set of indicators to define ecological status/condition, a monitoring and reporting system for these indicators and baselines and target values for each of them. Assessment and monitoring could be based on national forest inventories, other monitoring systems and remote sensing resources such as those in the Copernicus Land Services, to monitor restoration targets. Similar indicators to assess conservation status under the Habitats Directive (structure, composition and function, deterioration) could already be used to already define priority forest habitats for restoration action, thus allowing time to develop indicators

		and baseline for assessing progress to the good ecosystem condition. Until then, a first analysis of the level of degradation can already be undertaken based on available reporting data on parameters such as trees species composition (currently, 30 % have only one tree species) or stand structure (currently, more than two-third of Europe's forests are even-aged).
Option 3b: Restore degraded Annex I and non-Annex I habitats forest area to a good condition, with all necessary restoration measures completed on 15 % of degraded areas by 2030, 40 % by 2040 and 100 % by 2050.	In	This option combines option 1 and 3.

3.4 Impacts of assessed target options

The costs of restoration of forests were estimated by calculating the area of degraded ecosystems to be restored and re-created annually to meet each target and applying average per hectare capital costs for restoration and re-creation, and annual costs for maintenance taken from Tucker et al.[29] The costs of restoration include the capital costs of restoration actions such as removal of invasive species, restructuring plantations, planting or regeneration of trees, controlled burning, pest and disease control, hydrological works and sustainable forest management planning/ certification. The costs of re-creation include site preparation works, planting trees and/or creating appropriate conditions for natural regeneration, and initial management of newly created forests. Annual maintenance costs include sustainable forest management, fire prevention & control, control of grazing / deer management, and costs of avoiding or sustainably maintaining timber harvesting. The required management will be undertaken largely by private landowners and land managers, in return for incentive payments which include compensation for opportunity costs relating to land management (e.g. income forgone through reduction/cessation of timber harvests, loss of crop or grazing income through creation of forests on agricultural land). Maintenance costs were applied to the entire ecosystem area, since meeting the targets requires further degradation of ecosystems to be avoided.

Benefits estimates were based on an extensive review of literature of the value of benefits of forest restoration, which identified changes in per hectare values of ecosystem services for restored vs

[29] Tucker et al., (2013) Estimation of the financing needs to implement Target 2 of the EU Biodiversity Strategy. Report to the European Commission. Institute for European Environmental Policy, London. Available at: https://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/Fin%20Target%202.pdf

degraded ecosystems. The analysis applied an estimate of the per hectare value of the total ecosystem service benefits of forest restoration taken from a meta-analysis by De Groot et al[30], which was based on 58 source studies. The carbon-specific value used in this assessment are based on a study by Welle et al[31]. This study calculated the carbon sink potential of European forests, according to various scenarios with different harvest intensities. This assessment assumes that harvesting is a main pressure that would need to be addressed, reflecting the pressures reported in section 3.2. In the Welle study, the baseline is calculated with reported data from Member States and with the applicable IPCC methodology to estimate biomass- and carbon stock and takes into account the 'state of naturalness' of EU forests. The carbon sequestration potential is calculated with the use of biomass expansion factors. The carbon calculation was performed considering only above and below-ground biomass. Dead wood, litter, and soil were not included. The carbon values used for this assessment reflect the results from the 'Back in Time'' scenario in the study, which assumes a reduction in average felling for the period of 2018-250 to the levels of 2003 – 2007 for felling of pulpwood and firewood. This assumption is rather conservative in respect of the restoration needs of European forests. For example, this assumes still a harvest intensity of 100% for Sweden. Therefore, the relatively limited estimated impact in terms of carbon benefits compared to other ecosystem types in this study should be interpreted with caution, and should be seen as an absolute minimum that could be achieved through conservative reductions in felling intensity only.

Per hectare benefits estimates were applied to the area of ecosystem restored to give annual estimates of total benefits. Annual costs and benefits were estimated over the period 2022 -2070, recognising that, while restoration takes place to 2050, further maintenance costs continue beyond that date, while restored ecosystems continue to provide benefits into the future. Annual cost and benefit estimates were discounted, applying a 4% social discount rate, and summed to calculate their total present value. This enabled total net present value (benefits – costs) and benefit: cost ratios to be calculated.

For all options, the principal actors involved in the restoration of forest habitats will be forest owners and forest managers. Forest ownership varies from very small and fragmented private-owned to large scale state-owned forests, and from small family-owned holdings to large estates owned by private companies. Around 40 % of the forest area in the EU is publicly owned. Around 60 % of the EU's forests are in private ownership, with about 16 million private forest owners. Across the EU there are major variations in ownership of forests.

The impact of restoration activities can involve certain costs for forest owners and forest managers, while it may impact their own use of forests or the related value of marketable goods and services (i.e. the opportunity cost of reduced harvesting levels). On the other hand, restoration activities might improve the resilience of forests and ensure a certain economic value of marketable products and services in the future (e.g. due to a reduced risk of damage). These dynamics could also have an indirect impact on the forest-based industries which are dependent on forest biomass

[30] De Groot et al., (2013) Benefits of Investing in Ecosystem Restoration.
[31] Welle et al., (2020) Waldvision für die Europäische Union. Available at: https://naturwald-akademie.org/wp-content/uploads/2020/11/Waldvision-fuer-die-Europaeische-Union.pdf

resources. Across the options, the 'opportunity costs' of options 2 and 3 are assumed to be the highest, because those would involve restoration of forests that are more intensely managed for wood production. In addition, more 'nature-based' or 'climate smart' forest management would to some degree depend on the willingness, know-how and adaptability of foresters.

For public governance and oversight of the different options, it is likely that option 1 and 2 would be least impactful in comparison to option 3. The main reason for this is that options 1 and 2 build on existing legal framework of the Birds and Habitats Directives, while option 3 would involve setting up a new set of formalised indicators to identify forest restoration and a new reporting and monitoring framework. The latter would thus involve more direct costs for implementation. But the benefits for option 3 are much more significant considering the share of non-Annex I forests and their poor condition.

Forest restoration actions will benefit society, as well as specific sectors and groups benefiting from particular forest ecosystem services:

- Healthy forest ecosystems can generate additional income to society and ensure employment in the forest-based sectors;
- Recreational users and the tourism and recreation sector will benefit from enhanced recreational use of forests;
- Conservation organisations and contractors will benefit from investments in restoration, which will enhance revenues and employment in restoration actions;
- Local communities could benefit from positive effects of restoration, e.g. by helping them adapt to climate change, and because of enhanced biodiversity values, water -and soil quality;
- All EU citizens and economic sectors will benefit from mitigation of climate change and the reversal of biodiversity loss.

Costs and benefits of forest restoration are merely outlined in abstract below.

Forest restoration involves benefits for:

- **Biodiversity.** Restoring forests to favourable conservation status will enhance biodiversity. Biodiversity is widely recognised to have intrinsic value, such that there are benefits in enhancing biodiversity, in addition to the ecosystem services it delivers to people. Biodiversity also provides significant value to the health, functioning and resilience of ecosystems as such;
- **Provisioning services**, including timber products and non-timber forest products. This can include indirect economic benefits for the broader forest-based sector, in terms of market value, and employment for rural communities;
- **Regulating services,** including water- and soil quality, flood prevention, carbon sequestration and storage, and increased resilience against natural disturbances (droughts, fires, pests, and diseases);
- **Social and cultural services** that forests provide (aesthetic, spiritual, recreational and existence values).
- **Economy and employment.** Restoration work provides employment opportunities and income for conservation organisations, as well as contractors and suppliers. Restoration is also assumed to increase employment in the tourism and recreation sectors, while restored ecosystems have the

potential to attract more visitors, stimulating expenditure and supporting employment in rural economies;

Forest restoration can involve costs for:

- **Changes in forest management practices, active restoration measures**, **or recreation** of additional land to achieve FCS**.** These may depend on the current status of habitats and specific measures needed to improve their condition.
- **Provisioning services.** Costs can include the opportunity costs of biomass harvests, in the case restoration activities involve a decrease in harvest intensity. This can involve indirect economic costs for forest owners and the forest-based sector, in terms of market value and employment. **Implementing afforestation and reforestation** may include foregone income of landowners and practitioners from production on agricultural land, and costs for the preparation of the soil in case of plantation, for acquiring and planting trees, and for the maintenance and management practices. Costs depend on specific situation factors, including the type of tree species planned to be used.
- **Regulating services;** afforestation and reforestation may involve negative impacts on regulating services, including biodiversity and soil organic carbon.
- **Administrative burden for forest owners and forest managers** may increase, depending on potentially new monitoring and reporting requirements in relation to the options considered.

A cost-benefit analysis for forest restoration in the EU is complicated by several factors, including the variety of forests across the EU, gaps in data at EU level, uncertainties regarding baselines and future developments (e.g. markets, climatic) which may affect the estimated costs for action or non-action of forest restoration in the longer term. Due to the constraints outlined above, the cost estimates below are a highly *indicative* range of the scale of monetary costs and benefits from forest restoration. They need to be interpreted with caution. The following issues should be considered:

- **Restoration required:** (i) for option 1 the average estimated restoration potential of Annex I forests provided by the EEA based on the share of Annex I forest area reported as not in good condition by Member States has been used; (ii) To estimate the restoration potential (area) for option 3, the indicator of the share of single-species forest out of total forest area (25 %) has been used; (iii) To estimate the restoration required for option 2, it has been assumed to restore degraded Annex I forest habitat area in combination with the restoration potential for non-Annex I forests.
- **Unit values:** The cost-benefit analysis for three options is based on the same unit values for both maintenance, forest restoration and re-creation, as well as benefits of restoration. This is rather speculative, while significant variations can be assumed across biogeographical regions, as well as between Annex I and non-Annex I forests. The analysis further uses the same value unit value per hectare for restoration and recreation.
- **Gaps:** the assessment below does not include costs for the development of indicators and a monitoring and reporting system. Because of the complexity and lack of data, the assessment provides conservative minimum also does not include separate estimates of the benefits from increased carbon sequestration, which are almost certainly underestimates.

Table III-3: Summary of projected costs (MEUR) of achieving restoration targets for HD Annex I forests in relation to current trends & expected 2030 baseline based on overall degradation extent and combined measures. (Option 1a)

Period	% Full restoration	Maintenance costs	Restoration costs	Re-creation costs	Combined costs	Total over period
Average annual costs						
2022-2030	15 %	1,282	790	25	2,097	18,875
2031-2040	40 %	1,290	1,185	38	2,513	25,130
2041-2050	90 %[32]	1,306	2,370	75	3,751	37,514
Cost over full period (29 years)						
2022-2050	90 %	37,504	42,661	1,355	**81,520**	

Table III-4: Summary of projected costs (MEUR) of achieving restoration targets for HD Annex I forests in relation to current trends & expected 2030 baseline based on overall degradation extent and combined measures. (Option 1b)

Period	% Full restoration	Maintenance costs	Restoration costs	Re-creation costs	Combined costs	Total over period
Average annual costs						
2022-2030	30 %	1,285	1,580	50	2,916	26,241
2031-2040	60 %	1,298	1,422	45	2,765	27,648
2041-2050	90 %	1,310	1,422	45	2,777	27,770
Cost over full period (29 years)						
2022-2050	90 %	37,643	42,661	1,355	**81,569**	

Table III-5: Summary of Benefits Estimates from Ecosystem Restoration

Ecosystem	Service valued	Benefits (EUR/ha/year)
Forests	Carbon storage and sequestration	39*
Forests	Total ecosystem services	2 072

**Likely to underestimate true carbon benefits*

Tables III-6 summarise the cost and benefit estimates. The analysis finds that the ecosystem service benefits of restoring Annex 1 forests will exceed the costs by a factor of 4, while benefit cost ratios for wider forest restoration targets (Options 2 and 3) are estimated at 6:1. The estimated carbon benefits represent only 10% of estimated costs, but are likely to be a significant underestimate. In addition, forest restoration delivers substantial benefits for biodiversity, water, flood management, landscape, cultural heritage and recreation.

Table III-6: Cost-benefit ratio table (2022-2070) (MEUR, Present Value)

[32] Although the 2050 target aims to restore 100 % of the habitat, the 2050 cost estimation is for 90 % restoration as this is the maximum percentage that can be expected in practice. Furthermore, an extrapolation of current restoration costs would no longer provide reliable estimates in the range between 90 and 100 %. (See methodology section in SWD)

	Cost estimate Option 1a 15 % -40 % -90 %	Cost estimate Option 1b 30 % -60 % -90 %
COSTS		
Maintenance	27,641	27,720
Restoration	21,751	25,326
Re-creation	691	804
TOTAL (full recovery)	50,082	53,850
BENEFITS		
Carbon only	3,832	4,701
Total Ecosystem Services	203,564	249,775
Net Present Value (full recovery)		
Carbon only	-46,251	-50,019
Total Ecosystem Services	153,482	195,925
Benefit: Cost Ratio (full recovery)		
Carbon only	0.1	0.1
Total Ecosystem Services	4.1	4.6

Table III-7: Cost-benefit ratio table Options 2 and 3 (2022-2070) (MEUR)

	Cost estimate Option 2	Cost estimate option 3
COSTS		
Generalised restoration measures and costs	124 416	80 241
BENEFITS		
Carbon only	13,998	9,028
Total Ecosystem Services	743 700	479 635
Net Present Value (full recovery)		
Carbon only	-110 418	-71 213
Total Ecosystem Services	619 284	399,395
Benefit: Cost Ratio (full recovery)		
Carbon only	0.1	0.1
Total Ecosystem Services	6.0	6,0

3.5 Synthesis

Table III-8 provides a summary of the analysis of target options and conclusions in relation to their effectiveness, efficiency, coherence, and proportionality. The overall conclusion is that there are strong arguments for legally binding targets for achieving favourable conservation status of HD Annex I forest habitats; for targets to improve the condition of forest dependent species, as well as to restore non-HD Annex I forests.

The available valuation evidence suggests that even without carbon benefits included, the benefits from restoration would far exceed the costs in all three options. All options have however certain constraints. The first option is constrained by its geographical scope and does not address the condition of forests outside of the scope of HD Annex I habitats. This means that this option has a natural limit in terms of its effectiveness for enhancing biodiversity and climate change mitigation- and adaptation.

The second option overlaps with both option 1 and 3 and is in principle unlimited in terms of forest area covered. This means that its potential in terms of area covered may be the highest across options. The effectiveness of this option may however depend on the specific actions taken to improve condition of species and their effect on overall ecosystem health, both in- and outside of the Annex I.

Option 3 addresses non-Annex I forests and is mutually exclusive to option 1. This option would be more complex to implement, while indicators and a monitoring and reporting system would need to be established, involving certain costs. However, this option has a high potential considering the poor state of forests outside of the HD Annex I, for biodiversity as well as climate change mitigation- and adaptation.

In conclusion, while all options have certain benefits and constraints, policy options include: (i) one of the three target options; (ii) a combination of option one and three; (iii) a combination of option 1 and 2; and (iv) a combination of option 1 and 2; and (iv) a combination of option two and three.

Table III-8: Overview table assessing options on EU impact assessment criteria

	HD Annex I forests	EU protected species	Non-HD Annex I forests
Feasibility / effectiveness	Very high feasibility and potential for restoration. Effective in maintaining carbon stores, recovery of vegetation, carbon sequestration and other ecosystem services.	High feasibility and potential for restoration. Effective in maintaining carbon stores, and recovery of vegetation, carbon sequestration and other ecosystem services. Certain dependence on actions taken to enhance species' condition.	Moderate/high feasibility, very high potential for restoration. Effective in enhancing carbon sinks and recovery of vegetation, and other ecosystem services.
Efficiency	Strong evidence of benefits of restoration for biodiversity and ecosystem services, including climate mitigation. Available valuation evidence suggests ecosystem benefits exceed restoration costs.	Strong evidence of benefits of restoration for biodiversity and ecosystem services, including climate mitigation. Available valuation evidence suggests ecosystem benefits exceed restoration costs.	Strong evidence of benefits of restoration for biodiversity and ecosystem services, including climate mitigation. Available valuation evidence suggests ecosystem benefits exceed restoration costs;

Coherence	Full coherence with EU environmental policies and climate goals. Moderate potential to make contribution to climate adaptation and mitigation.	Full coherence with EU environmental policies and climate goals. High potential to make contributions to climate adaptation and mitigation.	Full coherence with EU environmental policies and climate goals. High potential to make contributions to climate adaptation and mitigation.
Proportionality	Proportionate due to the very high importance of forest habitats for biodiversity and associated ecosystem services.	Proportionate due to the high importance of forest habitats for biodiversity and associated ecosystem services.	Proportionate due to the high importance of forest habitats for biodiversity and associated ecosystem services.
Conclusions	**Include with very high priority.**	**Include with high priority.**	**Include with high priority.**

3.6 Forest ecosystem indicators

Many forest ecosystems across the EU provide evidence of the decline of biodiversity. For this reason, options for restoration action need to be considered for forests areas in addition to those covered by the Annex I habitats types under the Habitats Directive. Methods already exist to determine good condition of the Annex I habitat types and options for restoration targets for these were described in the previous sections. For habitat types or ecosystems not covered by the Habitats Directive, specific indicators can be used to provide evidence of enhancement of biodiversity. This section provides an assessment of introducing an obligation for Member States to provide evidence of increasing trends for a set of indicators that indicate the improvement of condition and biodiversity.

The European Union (EU) is home to approximately 5% of the world's total forest area. The EU27 has approximately 180 million hectares (ha) of forest and other wooded land in 2020 (European Commission, 2021b) which would account for approximately 40% of the EU's total land area – although estimates do vary. Six Member states (Sweden, Finland, Spain, France, Germany and Poland) account for two thirds of the EU's forested areas.

Forests are the largest terrestrial ecosystem in the EU[33], but the amount of forest area in the EU varies widely by Member State. In Finland for example, over three quarters of total land area is wooded, while in the Netherlands less than 10% is wooded, and in Malta less than 1%.

Forest coverage in the EU increased year-on year-from 2000–2015, by approximately 413 000 ha per year and 6.2 million hectares (Mha) in total[34]. According to the latest data from Forest Europe (Forest Europe, 2020), forest area in the EU-28 continued to increase between 2015–2020, by more than 1 Mha. Forest area in Europe altogether has increased by 9% since 1990, reaching 227 Mha[35].

However, the rate of forest expansion in the EU has overall declined since 2010[36] and recent data suggest there has also been an important increase in the amount of clear-cut harvested forest area[37].

The N2000 network, which covers almost 18% of EU land area, is about half forest. This means that around 23% of forest area in the EU-28 is protected under Natura 2000[38,39,40].

Definition of degraded forest ecosystems[41]
The notion of degradation is associated with a persistent decline of the ecological condition of an ecosystem[42]. Where ecosystem condition refers to the physical, chemical and biological condition

[33] Rendon, Paula, et al. "Analysis of trends in mapping and assessment of ecosystem condition in Europe." *Ecosystems and People* 15.1 (2019): 156-172.
[34] (EC JRC, 2018)
[35] (Forest Europe, 2020).
[36] EC JRC, 2018
[37] Ceccherini, Guido, et al. "Abrupt increase in harvested forest area over Europe after 2015." *Nature* 583.7814 (2020): 72-77.
[38] Sotirov, Metodi. "Natura 2000 and forests: Assessing the state of implementation and effectiveness." *What science can tell us* 7 (2017).
[39] Maes et al., 2020
[40] EC, 2015
[41] generic definition, valid for all forest-related targets and indicators
[42] United Nations et al., 2021

or quality of an ecosystem at a particular point in time[43]. The Millennium Ecosystem Assessment has defined ecosystem condition as the capacity of an ecosystem to deliver ecosystem services, relative to its potential capacity[44]. The SEEA-EA of the United Nations[45] defines ecosystem condition as the overall quality of an ecosystem asset in terms of its characteristics.

A moderate use of forest ecosystem services is often positively related to ecosystem condition. However, intensive use of provisioning ecosystem services has mostly a negative impact on ecosystem condition and may results in ecosystem degradation. The overuse of provisioning services such as wood can effectively act as a pressure on forest ecosystems. To avoid over-exploitation of provisioning services, safe thresholds need to be set and well-designed indicators could reflect these limits[46].

European forests are far from a natural, stable and resilient, showing largely 'moderate' ecological spatial structure as otherwise typical of undisturbed vegetation, especially in northern latitude forests[47]. According to Potapov et al[48], some areas in Europe are extremely poor of intact forest landscapes. According to Forest Europe, in 2020, 67% of the forest area consists of two or more tree species, with single-species forest being most common in South-East Europe, with a share of 62.3% of its forest area.

Tree health is deteriorating in the European forests (ICP-Forests Brief 5[49]). The crown defoliation indicator shows that the proportion of fully foliated trees has declined over the past 30 years, while mean defoliation has increased, particularly since 2010.

Insects (among biotic factors) and drought (among abiotic factors) are the most frequently reported causes of tree damage. Recent episodes of severe drought have increased crown defoliation and reduced tree growth. This may be exacerbated by air pollution.

The implementation of EU policy on air pollution has reduced the direct pressure of air pollutants on forests. However, nitrogen deposition remains very high in many European regions. There is increased evidence of nutrient imbalances in forest trees across Europe[50].
Canopy mortality has consistently increased across Europe in the past three decades. An important indicator of increasing pressure on forest ecosystems is tree mortality, that is, the proportion of canopy trees dying per year from both natural and human causes. An analysis of satellite data at 19,896 plots shows that canopy mortality in 35 European countries increased from 1985 to 2018 (+1.5% yr^{-1}). Similarly, in Europe's temperate forests canopy mortality increased by +2.40% $year^{-}$

[43] Maes, Joachim, Benjamin Burkhard, and Davide Geneletti. "Ecosystem services are inclusive and deliver multiple values. A comment on the concept of nature's contributions to people." *One Ecosystem 3 (2018)* (2018).
[44] (MA 2005)
[45] UN, System of Environmental-Economic Accounting, Ecosystem Accounting (2021) https://seea.un.org/sites/seea.un.org/files/documents/EA/seea_ea_white_cover_final.pdf
[46] Maes et al, 2018
[47] De Rigo, D., et al. "Forest resources in Europe: an integrated perspective on ecosystem services, disturbances and threats." *European Atlas of Forest Tree Species; San-Miguel-Ayanz, J., de Rigo, D., Caudullo, G., Houston Durrant, T., Mauri, A., Eds* (2016): 8-19.
[48] Potapov, Peter, et al. "Mapping the world's intact forest landscapes by remote sensing." *Ecology and Society* 13.2 (2008).
[49] Almost **a third** of monitoring plots (monitoring plots: 7440 in 36 countries) show moderate to severe defoliation. Mean defoliation between 2010 and 2019 remained unchanged on 68.3% of plots, increased on **22.3%** of plots and decreased on only 9.4%. https://icp-forests.org/pdf/ICPForestsBriefNo5.pdf
[50] https://icp-forests.org/pdf/ICPForestsBriefNo2.pdf; https://icp-forests.org/pdf/ICPForestsBriefNo3.pdf; https://icp-forests.org/pdf/ICPForestsBriefNo4.pdf

[1], doubling the forest area affected by mortality since 1984. Changes in climate and land-use are likely causes of large-scale forest mortality increase. These changes might have important implications for carbon storage and biodiversity conservation[51].

A number of other references are available on forest degradation[52].

Forest and restoration

A comprehensive approach to preserve and restore the diversity of an ecosystem must consider its structural, compositional, and functional characteristics, which are derived from quantifiable and/or quantitative ecosystem indicators and parameters (attributes). The good ecological condition of forest habitats is found when these characteristics correspond to a target condition of a nature-close, resilient ecosystem state (reference condition, habitat and site-specific)[53].

Ecological restoration[54] aims to re-establish a self-organizing ecosystem on a trajectory to reach full recovery. While restoration activities can often place a degraded ecosystem on an initial trajectory of recovery relatively quickly, full recovery of the ecosystem can take years, decades, or even hundreds of years. For example, while we can initiate a forest restoration process by planting trees, for full recovery to be achieved, the site should be a fully functioning forest with mature trees in the age-classes representative of a mature native forest.

In the absence of definition of what good condition is for specific forests (for example for forests habitats beyond the Annex 1 habitats of habitat directive), one can use a set of indicators that provide evidence of the enhancement of biodiversity in forest ecosystems.

Indicator selection

For the initial stage in this analysis, a broad set of indicators were considered as a means of gauging the improvement of biodiversity in forest ecosystems. Even though ecosystem condition for these ecosystems is not defined, evidence of an increasing trend in a set of indicators would act as a proxy for improvement in biodiversity. A set of such indicators could thus constitute specific legal obligation of improvement of the indicators in the legal proposal.

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[51] https://www.sciencedirect.com/science/article/pii/S259033222100227X; https://www.nature.com/articles/s41467-018-07539-6

[52] Dajoz, R. (2000). Insects and forests: the role and diversity of insects in the forest environment. Intercept Limited, Andover, UK 668 pp.; FAO (2010). Global Forest Resources Assessment 2010 - Main report. Food and Agriculture Organisation of the United Nations (FAO). Innes, J.L., and Tikina, A.V. (2017). Sustainable Forest Management - From Concept to Practice. Routledge, UK. MA, 2005. Ecosystems and Human Wellbeing: Current State and Trends, Volume 1, Island Press, Washington D.C. Maes J, Teller A, Erhard M, Grizzetti B, Barredo JI, Paracchini ML, Condé S, Somma F, Orgiazzi A, Jones A, Zulian A, Vallecilo S, Petersen JE, Marquardt D, Kovacevic V, Abdul Malak D, Marin AI, Czúcz B, Mauri A, Loffler P, Bastrup-Birk A, Biala K, Christiansen T, Werner B (2018) Mapping and Assessment of Ecosystems and their Services: An analytical framework for ecosystem condition. Publications office of the European Union, Luxembourg. Millar, C.I., and Stephenson, N.L. (2015). Temperate forest health in an era of emerging megadisturbance. Science, 349 (6250), 823-826 Raffa, K.F., Aukema, B., Bentz, B.J., Carroll, A., Erbilgin, N., Herms, D.A., Hicke, J.A., Hofstetter, R.W., Katovich, S., Lindgren, B.S., Logan, J., Mattson, W., Munson, A.S., Robison, D.J., Six, D.L., Tobin, P.C., Townsend, P.A., and Wallin, K.F. (2009). A Literal Use of "Forest Health" Safeguards against Misuse and Misapplication. Journal of Forestry, 107 (5), 276-277. United Nations et al. (2021). System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA EA). White cover publication, pre-edited text subject to official editing. van Lierop, P., Lindquist, E., Sathyapala, S., and Franceschini, G. (2015). Global forest area disturbance from fire, insect pests, diseases and severe weather events. Forest Ecology and Management, 352, 78-88

[53] Examples for such parameters are: habitat extent; forest landscape: parcelling and fragmentation outer edge structure and length; trees species composition; forest regeneration dynamics (species abundance in natural regeneration patches and its spatial coverage; inner edge structure: patches, gaps); structural stand attributes (following successional or management development stages): vertical vegetation structure, volume of dead wood); signs of mechanical disturbance (e.g. soil damage - compaction, landslides, road-side erosion, hydrological disturbances, etc...).

[54] https://www.ser-rrc.org/what-is-ecological-restoration/

The process of indicator selection is grounded on extensive work carried out over several years as part of the MAES[55] and the UNSEEA EA[56] initiatives that have been developing methodologies and indicators to reflect the condition of a number of ecosystems. These initiatives have led to identify indicators describing trends in forest ecosystems condition, that are relevant, based on available data, repeatable through time, and ecologically meaningful in terms of ecosystem structure, function and composition. Moreover, these indicators have undergone various consultation processes based on scientific expertise, as well as including MS experts and stakeholders.

Based on the above, a broad number of potential indicators were first identified and a set of criteria were developed to select the most promising indicators as potentially acting as a good proxies for improvements in biodiversity. In order to be operational in the short term, such indicators would have to satisfy a number of criteria, such as being based on data that are already available or will shortly be available in the EU. Therefore the criteria chosen for the purpose of the current evaluation of indicators were:

1. The indicator gives direct information about the state of biodiversity or the ecological quality of the ecosystem. Based on this, pressure indicators were excluded as often being indirect indicators of biodiversity.
2. The data are readily available or will shortly be available in the EU, and the data are reliable and is updated periodically.

The indicators outlined below were evaluated against these criteria (see Table 1). Indicators need first to offer key information or proxy about the condition and biodiversity quality of forest ecosystems. Data availability and data robustness, in particular periodicity of updates and reliability, are also essential elements to consider. In particular indicators for which there are already obligations for reporting under other legislation (such as CAP or LULUCF), or already used in other pan European or international processes (Forest Europe or FAO), were considered favourable elements in this respect.

The evaluation allowed a reduction to a final assessment of six indicators satisfying the criteria considered: Structure diversity (age structure), forest connectivity/fragmentation, tree cover density, amount of deadwood, organic carbon content in forest soils, and common forest birds indicator. Further information about these selected indicators is provided in the subsequent sections.

Table III-9: Considered forest ecosystem indicators

SEEA Typology	Indicator	Direct indicator of ecological/biodiversity quality	Temporal series available	Data Stream	Final assessment
Class A1 **Physical state**	**Normalized difference water index (NDW)**	No, indirect measure of ecological/biodiversity quality	yes	Mapping	No
Class A1 **Chemical state**	**Air pollutants**	No, indirect measure of ecological/biodiversity quality	yes	EU reporting (NEC Directive)	No
	Exceedance of critical loads for acidification	No, indirect measure of ecological/biodiversity quality	Yes	Mapping	No

[55] Mapping and Assessment of Ecosystems and their Services - MAES - Environment - European Commission (europa.eu)
[56] Ecosystem Accounting | System of Environmental Economic Accounting

	Exceedance of critical loads for eutrophication	No, indirect measure of ecological/biodiversity quality	Yes	Mapping	No
	Organic carbon content in forest soils	Yes, strongly associated with key services like water holding capacity, resilience improvement, and is related to management practices	Yes, reported in Forest Europe	Mapping Source : LUCAS Soil,, ICP Forests	Yes
Class B1 - **Compositional state**	**Common Forest Bird indicator**	Yes, strongly associated with associated biodiversity and is related to management practices	Yes	Mapping Source : PECBMS	Yes
	Tree species composition	Yes and No, measure of ecological/biodiversity quality but not completely relevant	Yes	Mapping Source : National Forest Inventories (NFI), Forest Europe, FAO-FRA	No
Class B2 - **Structural state**	**Forest biomass**	No, indirect measure of ecological/biodiversity quality	Yes/no	Mapping Source : NFI, Forest Europe	No
	Growing stock	No, indirect measure of ecological/biodiversity quality	Yes	Mapping Source : NFI, Forest Europe	No
	Tree cover density	Yes, key aspect in ecological condition, biodiversity, ecosystem structure, biogeochemical processes, animal habitat, biomass and carbon sequestration, and anthropogenic demand for building materials	Yes	Mapping Source : Copernicus	Yes
	Deadwood	Yes, strongly associated with associated biodiversity and is related to management practices	Yes	Mapping Source: NFI, Forest Europe	Yes
	Age structure	Yes, strongly associated with associated biodiversity and is related to management practices	Yes	Mapping Source: NFI, Forest Europe	Yes
Class C1 – **Landscape & seascape**	**Forest connectivity**	Yes, strongly associated with key aspect in biodiversity, ecosystem services and the ever-increasing pressure from anthropogenic land use	Yes	Mapping based on CLC (JRC, Forest Europe)	Yes

Age structure - share of uneven-aged structure

Background

According to Forest Europe (2020), even aged forest dominate in Europe's forests available for wood supply (FAWS)[57].

Species-rich communities thrive within forests that are diverse in structure – for example, bird diversity has been shown to be strongly influenced by the vertical heterogeneity of forest stands; tree communities with differing bark characteristics can support high biodiversity by providing

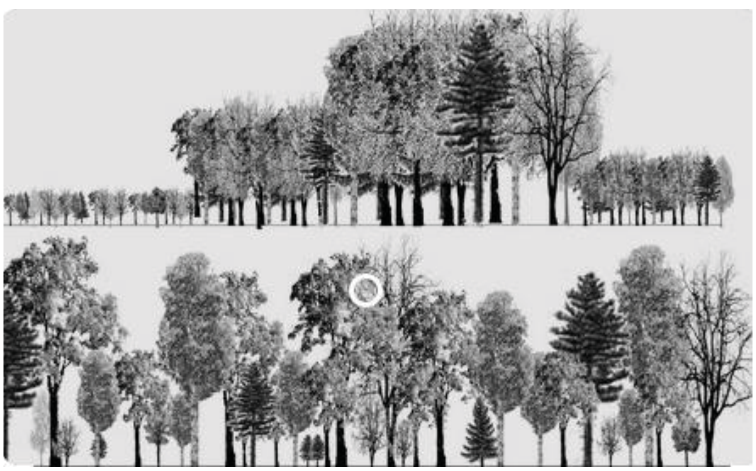
[57] According to FOREST EUROPE most EU forests, 85%, are FAWS, i.e. potential sources of wood. FOREST EUROPE defines FAWS as "forests where any environmental, social or economic restrictions do not have a significant impact on the current or potential supply of wood. These restrictions can be established by legal rules, managerial/owner's decisions or because of other reasons".

numerous different microhabitats; and saproxylic organisms (which depend on decaying wood) prefer environments with differing volumes and decay classes of deadwood[58].

A variety of layers of vertical vegetation (co-existing on the same square) allows the multiplication of habitats for a wide diversity of species.

Emberger, Larrieu and Gonin (2017)[59] suggest that forest management for both wood production and high taxonomic biodiversity could be guided by key principles as such increasing the number of living environments: promoting structural and compositional heterogeneity (in terms of species and ages of forest stands and stages of decomposition of dead wood) will in turn promote a varied range of habitats, which will increase the chances of meeting the varied ecological requirements of forest species.

Figure III-2 Schematic representation of the difference at the stand scale between (a) stands subjected to even-aged silviculture at four different developmental stages and (b) stand subjected to uneven-aged silviculture. Source: Nolet et al, 2017



Details of the indicator

This indicator describes the age-class structure of forests available for wood supply (FAWS). The vast majority of forest in Europe are FAWS and they represent 85% of EU forests. Information on age structure is key for understanding the history of forests and their likely future development.

This indicator is important for understanding not only for wood supply but also to describe the ecological condition of forest ecosystems because provides insights regarding the provision of essential ecosystem services and biodiversity. These are in general more favourable in uneven-aged forest, and in old even-aged forests compared to young even-aged forests.

[58] Storch, Felix, Carsten F. Dormann, and Jürgen Bauhus. "Quantifying forest structural diversity based on large-scale inventory data: a new approach to support biodiversity monitoring." *Forest Ecosystems* 5.1 (2018): 1-14.

[59] Emberger, Larrieu, Gonin, Dix facteurs clés pour la diversité des espèces en forêt, Forêt Entreprise, Forêt Privée Française, 2017, mars (233), pp.53-53. ⟨hal-02624397⟩

In Europe more than 70% of FAWS are reported as even-aged. Therefore, uneven-aged forests cover barely 30% of the FAWS area. It is noticeable that some countries report only aggregated information without distinguishing even-aged and uneven-aged forests, which might require improvements in reporting.

Description: This indicator describes the age-class structure of forest available for wood supply.

Source: NFI, Forest Europe

Units: Share (%) of area of even-aged forest (development phases) and of uneven-aged forest.

Time series: Information on historical trends (time series) of this indicator is limited. The last Forest Europe report on the State of Europe's Forest of 2020 indicates that data for the analysis of trends on age structure is limited and covers only 15% of FAWS in Europe for the period 2000-2015.

Use and references of this indicator:
Forest Europe

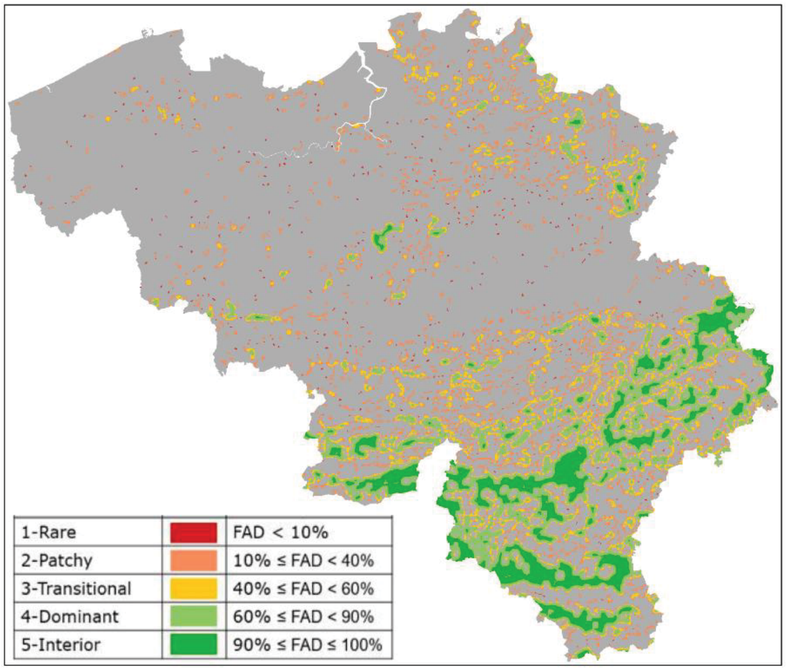
Forest connectivity

Background

Forest connectivity quantifies the degree of spatial intactness of forest cover. The higher the connectivity, the more thriving the forest ecosystem.

Forest connectivity is the opposite of forest fragmentation, i.e., highly connected ~ little fragmented and vice versa. The narrative of forest connectivity/fragmentation is of high importance in forest management.

Figure III-3 Forest Connectivity: Example for CORINE 2018 forest mask of Belgium showing five-class locally detailed reporting scheme. Source: Joint Research Centre (JRC)



Forest connectivity is a key aspect in biodiversity, ecosystem services and the ever-increasing pressure from anthropogenic land use. Forest fragmentation may lead to the isolation and loss of species and gene pools, degraded habitat quality, and a reduction in the forest's ability to sustain the natural processes necessary to maintain ecosystem health.

By affecting ecological processes, fragmentation affects ecosystem services such as habitat provision, pollination, and has also an impact on pest propagation in different ways.

Definition

Forest connectivity measures the degree of connectivity in forest ecosystems.

The methodological concept measures Forest Area Density (FAD) in the range of [0, 100] % at local (pixel) level, meaning at the highest spatial detail available. FAD is then grouped into five categories, showing varying degrees of connectivity/fragmentation within forest patches. The naming scheme of the five classes provides intuitive information for effective communication, i.e., the proportion of dominant or interior forest. Spatially detailed maps of connectivity/fragmentation are crucial to locate hotspots of fragmentation. Temporal changes in FAD allow to detect and to quantify changes in percent points, enabling monitoring of progress as well as measuring the overall outcome of policy directives.

Figure III-4 – Forest Connectivity: extract of statistical summary table for EU in 2018. Source: Joint Research Centre (JRC)

	A	B	C	D	E	F	G	H	I	J	K	L
1		Names & Codes		Base Statistics			Fragmentation Statistics					
2	Original sorting	COUNTRY	CNRTY_CODE	CNRTY_AREA 2018 (in ha)	FORES_AREA 2018 (in ha)	PERC_FOR 2018 (in %)	PERC_RARE (in %)	PERC_PATCH (in %)	PERC_TRANS (in %)	PERC_DOM (in %)	PERC_INT (in %)	FAD_AV (in %)
3	1	CLC	clc	584,572,992	200,918,750	34.37	0.42	7.37	8.99	83.00	0.22	71.90
4	2	EU28	eu28	439,019,328	159,505,733	36.33	0.47	7.79	9.14	82.36	0.24	72.01
5	3	Albania	AL	2,866,485	1,106,904	38.62	0.27	7.04	10.12	82.57	0.00	67.56
6	4	Austria	AT	8,394,356	3,715,822	44.27	0.19	5.87	9.81	84.12	0.00	69.05
7	5	Bosnia_Herzegovina	BA	5,121,534	2,656,470	51.87	0.14	5.07	3.94	90.84	0.00	74.54
8	6	Belgium	BE	3,064,066	628,981	20.53	1.28	18.63	15.50	64.59	0.00	60.89
9	7	Bulgaria	BG	11,098,772	4,237,649	38.18	0.45	7.14	8.15	84.26	0.00	73.21
10	8	Switzerland	CH	4,128,829	1,306,994	31.66	0.24	11.63	23.92	64.21	0.00	58.70
11	9	Cyprus	CY	924,891	189,190	20.46	0.31	4.71	6.92	88.06	0.00	77.44
12	10	Czechia	CZ	7,887,377	2,783,957	35.30	0.43	11.38	18.95	69.23	0.00	64.00
13	11	Germany	DE	36,057,024	11,042,562	30.63	0.73	12.00	17.04	70.23	0.00	63.72
14	12	Denmark	DK	4,363,230	521,455	11.95	3.01	36.39	31.39	29.05	0.17	44.57

The statistical summary chart provides details on forest cover (column E-F), five categories of forest connectivity/fragmentation (column G-K), and the average amount of connectivity within forest cover (column L) for each reporting unit (i.e., MS).

Indicator key advantages

- Map product: values at local level, identify hot spots and locations to act.
- Summary statistics by reporting unit: useful for charts and dashboards.
- Flexibility to adopt to various spatial analysis scales.
- Flexible reporting scheme to match any user requirement.
- Compatible to any kind of forest definition, i.e. FAO or CLC
- Applicable to any kind of land cover data source (CLC, Copernicus, etc)
- Normalized indicator in percent [%], facilitating interpretation and communication.
- Quantifying amount of change allows measuring progress and evaluate policy outcome.
- Possibility to aggregate to various reporting units (NUTS 1, 2 and 3, country, eco-region, etc.).
- Endorsed for official reporting by UN-FAO, Forest Europe, US-Forest Service.
- Endorsed for reporting in the upcoming EU Observatory on deforestation and forest degradation
- Harmonized assessment scheme across all MS.
- Peer-reviewed and well-established procedure.
- Operational processing implemented on JRC-BDAP and FAO-SEPAL

To be noted: requires user decision on appropriate forest map, forest definition, analysis scale and reporting scheme.

Data source:

JRC, CORINE, COPERNICUS

➢ Granularity, Periodicity & Timeliness:
- CORINE: EU and MS, 6Y, (T-3).
- CORINE Plus: once available
- any other suitable land cover map, i.e., Copernicus: Global, annual since 2015

Relevance:
Spatially explicit maps of forest connectivity are key elements for the assessment of forest biodiversity, habitat quality and ecosystem integrity. Temporal trends in forest connectivity form the baseline of sustainable forest management including targeted conservation and restoration

efforts. Locating and quantifying changes in forest connectivity allows for monitoring progress in policy directives (NRL, 8EAP, Green Deal, Biodiversity Strategy, Forest Strategy, 3 billion trees, SDG15 "Life on Land") and improving forest ecosystem health by mitigating forest risks.

Use and references of this indicator:
Resilience dashboard, Biodiversity Strategy, Green Deal, 8EAP, Forest Strategy.

Use in Commission publications and reports:

- ScienceHub: Forest Europe
- Forest Europe JRC Technical Report
- Science Hub: UN-FAO
- FAO: JRC Technical Report
- Technical factsheet on forest fragmentation
- Fact sheet 3.3.103, MAES 2020 report

Others uses:
Both, Forest Europe and UN-FAO have requested and adopted the proposed methodology for inclusion in their flagship reports State of Europe's Forest 2020 and The State of the World's Forests 2020. The methodology/indicator has been co-developed in the context of a Collaborative Research Arrangement with the United States Forest Service (USFS) for the past 18 years.

Hence, the indicator is fully operational and can be applied to any suitable land cover dataset. The reporting of the indicator can be fine-tuned to match various reporting requirements, for example number of connectivity classes or detail of spatial aggregation. The same indicator is also used for more than 15 years for official reporting by the USFS for reporting to the RPA assessment[60]. Forest connectivity/fragmentation is also used in the MAES 2020 report.

Tree cover density

Background

The amount and density of trees in forest is a fundamental trait of ecosystem structure, which underpin, among other processes, biogeochemical processes, and habitat for biodiversity, productivity and carbon sequestration.

An understanding of the extent and density of forest trees is necessary for monitoring the condition of forest ecosystems and assess the role of sustainable forest management.

Definition
Tree Cover Density is defined as the "vertical projection of tree crowns to a horizontal earth's surface".

Description
The indicator on tree cover density measures the proportional forest crown coverage per grid cell at very high resolution of 10-m using satellite data.

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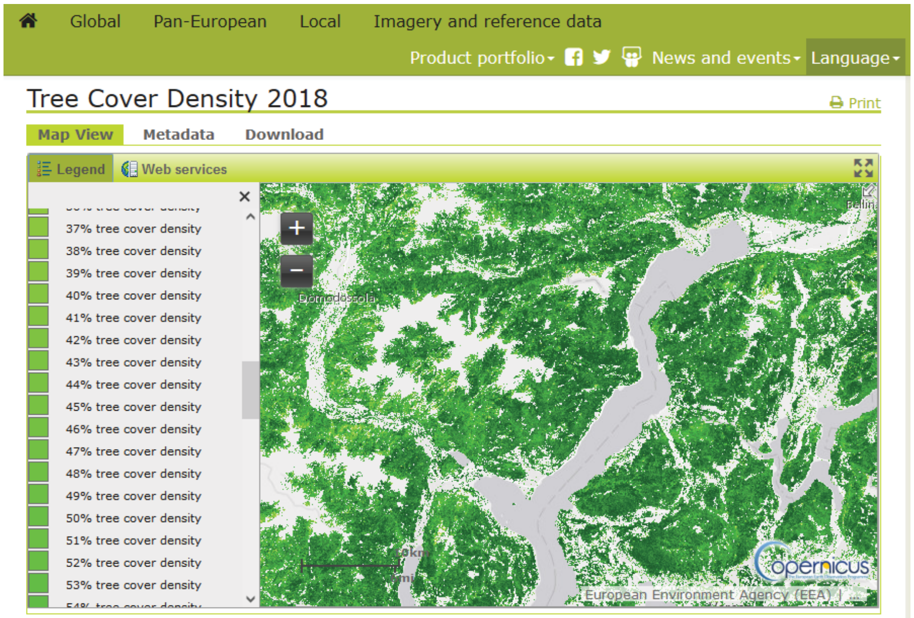
60 https://www.fs.fed.us/research/rpa/

Tree cover density describes the level of tree cover in a range from 0-100% on 10-m grid cells.

Units: Percent

Figure III-5 - Tree Cover Density in 2018



Time series

The muti-temporal character of the indicator facilitates monitoring and tracking changes of forest tree cover. So far, the indicator was produced for 2012, 2015 and 2018. In addition, a change product (tree cover change mask) showing gains, losses and stable tree cover is available for 2012-2015 and 2015-2018.

However, note that the tree cover change mask is a change product based on the binary tree cover masks of the primary status layers Dominant Leaf Type 2015 and 2018. Therefore, not derived directly from the data set of tree cover density.

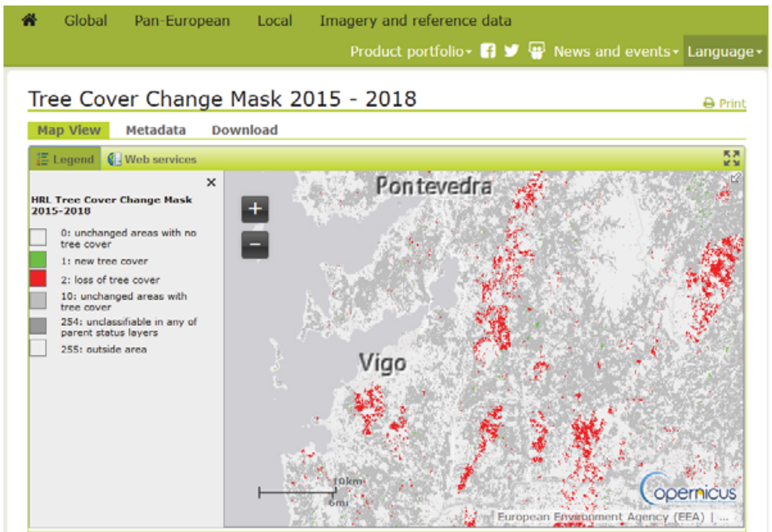
Indicator key advantages

- Tree cover loss (a decrease in density) can be the result of natural and/or man-made pressures. While an increase in tree cover density is the result of e.g. planting or natural regeneration. That means that the indicator is sensible to the effects of pressures such as fires, storms, insect infestations and harvesting. But also to the effects of restoration e.g. tree planting.
- Considering the limitations of remotely sensed imagery small changes in tree cover density at grid cell level could be the results of e.g. calibration effects. Nevertheless, the data set is appropriate for describing stand replacement disturbances, which might affect e.g. a cluster of grid cells representing a forest stand, therefore resulting in a reduction of tree cover density.
- In addition to tree cover density data, Copernicus disseminate high resolution forest change products for 2012-2015 and 2015-2018. The tree cover change mask (TCCM) 2015-2018 is a

change product based on the binary tree cover masks (TCMs) of the primary status layers Dominant Leaf Type 2015 at 20m spatial resolution and Dominant Leaf Type 2018 at 10m spatial resolution. The change maps describe four categories at 20-m grid cells:

- Unchanged areas with no tree cover
- New tree cover
- Loss of tree cover
- Unchanged areas with tree cover

Figure III-6 Tree Cover Change Mask 2015. Source: Copernicus



- The high-resolution forest change products could be used complementarily for assessing changes in tree cover.
- Tree cover density data can be used for mapping stand replacement disturbances, and new treed areas e.g. resulting from regeneration, using data for two years, e.g. 2015 vs 2018. The resulting map can be summarised in tabular form at country or sub-national level for accounting. Alternatively, the high resolution forest change products are readily available for tabular accounting tasks.

***Source of data**:* Copernicus (HRL)[61]

Use and references of this indicator:
New data set (indicator) part of the Copernicus "Forests - high resolution layers".

Dead wood

Background
The amount of dead wood as a critical environmental variable.

[61] Copernicus, tree cover density https://land.copernicus.eu/pan-european/high-resolution-layers/forests/tree-cover-density

Dead wood is a crucial proxy for biodiversity, representing the substrate (material base) for a large number of animal and plant species[62].

- Certain forest species – for example, some fungi, mosses and insects – are dependent on the presence of dead wood in a forest;
- Dead wood serves as a living environment for several thousand species.
- In Europe, it has been estimated that 20-40% of forest species are dependent on dead or dying wood, at some point in their life cycle[63]. These are known as ‘saproxylic’ species.

From the ecological point of view, there are two major explanations for why an increase in the amount of dead wood increases the number and density of species and diversifies the species composition.

- First, higher amounts of available dead wood lead to more dead-wood surface area and higher resource availability[64]. According to the island theory, we can therefore expect a higher species number on sampling units with a larger ‘‘island’’[65]
- Secondly, larger surface areas lead to more different available habitats[66].

Dead wood also contributes to the decomposition and circulation of organic matter and to the structural stability of soils, carbon sequestration, nutrient supply and water retention[67].

Many studies have shown the importance of different types of dead wood, i.e., tree species, decomposition stage, diameter, etc[68,69]. A critical consideration of most of these studies as well as an analysis of data revealed that in most survey data sets, there is a clear correlation between the amount and the diversity of dead wood.

A wide variety of deadwood types (standing and lying deadwood species, size, saproxylation stage etc.) is necessary to host a wide variety of saproxylic species and promote biogeochemical cycles.

In consequence, an adequate level of deadwood is crucial for the functioning of forest ecosystems.

The state of saproxylic species

Regarding species associated to forest habitats, several species, in particular, species relying on mature forests and dead wood are under pressure.

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62 Maes et al, Mapping and Assessment of Ecosystems and their Services: An EU ecosystem assessment. EUR 30161 EN, Publications Office of the European Union, 2020. ISBN 978-92- 76-17833-0, doi:10.2760/757183, JRC120383.

63 Bauhus, Baber and Müller, Deadwood in forest ecosystems, Ecology, Oxford bibliographies, 2018. doi: 10.1093/OBO/9780199830060-0196

64 Raabe et al, Drivers of bryophyte diversity allow implications for forest management with a focus on climate change, Forest Ecology and Management, Volume 260, Issue 11, 2010. https://doi.org/10.1016/j.foreco.2010.08.042.

65 MacArthur, Robert H., and Edward O. Wilson. The Theory of Island Biogeography: By Robert H. MacArthur and Edward O. Wilson. Princeton University Press, 1967.

66 Boecklen, W., Effects of Habitat Heterogeneity on the Species-Area Relationships of Forest Birds, Journal of Biogeography, Vol. 13, No. 1 (Jan., 1986), pp. 59-68 (10 pages), 1986.

67 Lachat et al, Deadwood: quantitative and qualitative requirements for the conservation of saproxylic biodiversity, in Managing Forest in Europe, 2013

68 Similä et al, Saproxylic beetles in managed and seminatural Scots pine forests: quality of dead wood matters, Forest Ecology and Management, Volume 174, Issues 1–3, 2003, Pages 365-381.

69 Heilmann-Clausen and Christensen, Does size matter?: On the importance of various dead wood fractions for fungal diversity in Danish beech forests, Forest Ecology and Management, Volume 201, Issue 1, 2004, Pages 105-117.

- In Sweden, 69% of the red-listed forest insects are saproxylic species; on the other hand, more than 20% of long-horned beetle species have declined in abundance since the 1950s and 10% have become extinct in the last 200 years, linked to the development of intensive industrial forestry.
- In Finland, at least 2% of the national fauna has been driven to extinction since 1800, 20% of saproxylic beetles are currently red-listed, and the reduction of dead wood in forests is considered the dominant threat to 34% of these listed species.
- In France and Germany[70], the proportion of rare or threatened saproxylic beetles reaches 35%.
- The European Red List assessment of 653 of the best known saproxylic beetle species reports 17% endangered or vulnerable species.

Deadwood volume at country level

At country level, the amount of deadwood ranges from 5.6 to 33.1 m3 / ha, with an average value of 15.8 m3 /ha[71].
Deadwood is mostly present in Central Europe, particularly in Slovenia (more than 30 m3 ha−1), Germany (29.6 m3 /ha), Slovak Republic (27.3 m3/ ha), Latvia (26.4 m3/ ha), Austria (23.7 m3/ ha), and France (22.3 m3/ ha) but high values are found also in Cyprus (26.9 m3 ha−1) and Sweden (24.4 m3/ ha)[72,73].

Definition

- According to FAO-FRA (2020) deadwood is "all non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil. Dead wood includes wood lying on the surface, dead roots, and stumps larger than or equal to 10 cm in diameter or any other diameter used by the country."
- **EAA**[74]
- Terminology is well defined for international reporting by Forest Europe. Deadwood (coarse woody debris) as such, and the methodology for reporting its volume are thus defined according to Forest Europe standards.

Measurement units

Status: m3/ha or tonnes/ha - Changes: m3/ha/yr.

Figures to be reported on

- Volume of dead standing trees (snags) and lying trees (logs) on forest area and other wooded land, classified by forest type.
- Minimum length and diameter of standing and lying dead trees: Length: 2 m.

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70 Kohler, F. "Totholzkafer in Naturwaldzel-len des nordlichen Rheinlandes. Vergleich-ende Studien zur Totholzkdferfauna Deutsch-lands und deutschen Naturwaldforschung [Saproxylic Beetles in Nature Forests of the Northern Rhineland. Comparative Stud-ies on the Saproxylic Beetles of Germany and Contributions to German Nature For-est Research]. Recklinghausen: Landesamt Agrarordnung NRW. 351 pp." (2000).

71 Mean values of deadwood volume (m3 ha-1) and their 95% confidence interval estimates distinguished by Country and deadwood type (see the text for acronyms). From Puletti, N., Canullo, R., Mattioli, W. *et al.* A dataset of forest volume deadwood estimates for Europe. *Annals of Forest Science* **76,** 68 (2019). https://doi.org/10.1007/s13595-019-0832-0

72 EEA, Forest: deadwood (2017) https://www.eea.europa.eu/data-and-maps/indicators/forest-deadwood-1

73 Forest Europe https://foresteurope.org/deadwood-2/

74 Ibid 43.

- Diameter: It is up to the countries to define the minimum size of diameter to be reported. It is recommended that the minimum size be: Standing deadwood: 10 cm diameter at breast height/ Lying deadwood: 10 cm mean diameter.

  Continuous improvement of methodology:
  - On a national scale, the monitoring of deadwood is carried out in several National Forest Inventories (NFIs). Work towards the harmonisation of terminology is carried out by the COST E43 action. This comprises type classification (standing, bending, lying) as well as potentially important additional parameters (uprooted stems, clear-cuts stems, pieces of stems, cut branches, uprooted staves, logging residues, fine woody debris, intact snags, broken snags, broken, lying stems without uprooting). There are several approaches to register state of decay, most commonly this is classified in five classes.
  - The EU forestry strategy 2021 has highlighted the need to better harmonize and improve NFIs. This should be the subject of a proposal in the Commission next year.

  Sources
- NFIs,
- Annual report of emissions and absorptions associated with dead wood within the framework of decision 529/2013 (LULUCF decision), which has been replaced by LULUCF regulation 841/2018.
  - The EU National Inventory Report (NIR) contains a brief description of the methodologies implemented by each Member State[75]
  - The more general methodological framework is set by the 2006 IPCC guidelines: see section 2.3. of chapter 2 of volume 4 and section 4.2.2 of chapter 4 of volume 4.
  - This annual reporting does not mean that there is annual reported data. Most of the data sets used by the Member States come from national forest inventories (NFI), the frequency of which is generally 5 to 10 years. An interpolation is then performed from two measurement points in time to arrive at an annualized report.

Use and references of this indicator

Biodiversity Strategy, Green Deal, 8EAP, Forest Strategy, Forest Europe, FAO-FRA.

Soil organic carbon in forest (SOC)

Background

Forests play a key role in the global carbon cycle as they contain enormous quantities of organic carbon, most of which is stored in soil with a smaller part being held in vegetation. The storage and distribution of organic matter (thus SOC) in forest soils can be seen as an indicator of forest ecosystem health. At sites where coniferous forests prevail instead of natural broad-leaved or mixed forests, soil carbon stocks in the mineral soil are usually lowered compared to broad-leaved or mixed forests (while SOC in the forest floor is typically higher indicating reduced biological activity). Among others, this is because broad-leaved forests have higher above- and belowground

[75] UNFCC, 2021 https://unfccc.int/documents/275968.

biomass thus higher SOC stocks[76], while the quality of broad-leaved forest litter favors higher biological activity, bioturbation, and eventually higher SOC storage[77].

Case studies across Europe indicate that current soil carbon pools may be significantly reduced below their potential SOC storage capacity[78]. While this effect is in detail site-specific (thus: large variation across Europe), some general effects can be assumed to having caused extensive historic SOC losses in forests:

– the continued removal of forest biomass through harvesting has extracted biomass and nutrients leaving less residues for decomposition and organic matter stabilization;
– historic biomass extraction (woody debris collection, litter raking, plaggen, forest grazing, stump removal) has additionally degraded forest soils;
– higher temperatures after harvesting favour decomposition thus loss of topsoil carbon; losses are also triggered through erosion (loss of SOC-rich topsoils along skidding trails, and on clear cuts);
– the drainage of wet mineral and organic forest soils has caused SOC losses;
– the introduction of coniferous tree species at many sites (which are otherwise stocked with natural, site-adapted broad-leaved tree species) has introduced lower quality and acidic litter, which slows and shifts decomposition into the forest floor (reduced bioturbation, less stabilized SOC in the mineral soil);
– at loamy and silty sites, typically shallow-rooting Norway spruce has conditioned longer phases of stagnic water, reducing decomposition;
– extensive historic long-range deposition of acids has lowered forest biomass productivity, and has contributed to shift decomposition from the mineral soil into the forest floor

It can be concluded that the capacity of forests to store organic carbon is strongly influenced by management practices (species selection and regeneration method), but also through disturbances such as forest fires and storms. Historic management has contributed to SOC losses (in some cases these losses may have been masked by gains in the forest floor as a typical sign of forest soil biological degradation). Carbon in the forest floor is more labile to decomposition than in the mineral soil[79]. Nowadays, climate change and increased disturbances threaten this fragile equilibrium (losing the mostly labile carbon in the forest floor), as it can be observed at many plantations and regeneration systems which remove most of the canopy, and which introduce coniferous species where otherwise broad-leaved species would thrive.

The **protective role of forest soils to store water, carbon, nitrogen and nutrients, and to filter and buffer contaminants,** can be ensured through restoration of SOC-declined forest soils. Restauration involves site-specific silvicultural systems and nature-close forestry.
Some functions of SOC of intact and healthy forest ecosystems are mentioned:

- Nature close forests, showing optimal mineral soil carbon storage, accompanied with thin, biologically active forest floors, provide species-diverse ecosystems rich in ecological niches.

[76] Finér, Leena, et al. "Variation in fine root biomass of three European tree species: Beech (Fagus sylvatica L.), Norway spruce (Picea abies L. Karst.), and Scots pine (Pinus sylvestris L.)." Plant Biosystems 141.3 (2007): 394-405.

[77] Wellbrock, Nicole, and Andreas Bolte. Status and Dynamics of Forests in Germany: Results of the National Forest Monitoring. Springer Nature, 2019.

[78] Eg. Clarke, Nicholas, et al. "Influence of different tree-harvesting intensities on forest soil carbon stocks in boreal and northern temperate forest ecosystems." Forest Ecology and Management 351 (2015): 9-19.

[79] Crow, Susan E., et al. "Increased coniferous needle inputs accelerate decomposition of soil carbon in an old-growth forest." Forest Ecology and Management 258.10 (2009): 2224-2232.

- Forests and ground vegetation in multi-layered, diverse forest ecosystems protect and stabilise soils by storing excess rain water, and by slowing down the lateral movement of water, soil and nutrients. These functions go parallel with replenished SOC pools and stable topsoils and soil structure, of particular importance in areas where landslides likely occur, and/or where floods are largely initiated.
- Naturally developed forest soils, including biologically active forest floors, offer a habitat for a large variety of decomposers and soil fauna[80], while holding a natural forest seed bank for forest regeneration.
- Forest soils, in particular organic soils, are the largest terrestrial carbon and nutrient reservoirs of managed terrestrial ecosystems.

Soil organic carbon (SOC) dynamics in forests depend on the amounts and quality of litter, climate and type and location of soil biological activity. Management activities can influence soil C stocks in forests by altering the rates of input or release of C from soils. In degraded forest ecosystems, a large proportion of decomposition and biological activity happens in the forest floor, accompanied by reduced bioturbation, and increase in fungal activity and reduced bacterial activity.

Indicator*:* Change in forest SOC stock.

$\Delta SOC_{total} = SOC_{0\text{-}30} + SOC_{OF+OH\ horizons}$[81]

Description: Increase stock of $SOC_{0\text{-}30}$[82] in mineral soils while avoiding net loss of total forest SOC stock [t/ha/yr]

Source**:** Forest SOC change is a subindicator of Forest Europe's Indicator 2.2 Soil condition (currently only mineral soil) as well as reported by countries in their annual greenhouse gas inventories (for soil as well as forest floor humus horizons[11]).
Data from LUCAS Soil, ICP Forests.

Methodology**:**
Based on IPCC (2006), methods that are available to use and evaluate the national forest soil monitoring data in order to develop country-specific data, applying a standardized soil depth 30 cm, while it is good practice to also cover lower soil depths.

In UNFCCC reporting, there is often confusion whether all forest floor horizons are counted towards the 'litter' pool. Strictly following soil nomenclatures, litter represents only the hardly decomposed top horizon of the forest floor (OL). Because OL is difficult to sample and because it has very high spatial and temporal variability, the OL horizon is excluded here[83].

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80 Hale, Cindy M., et al. "Effects of European earthworm invasion on soil characteristics in northern hardwood forests of Minnesota, USA." Ecosystems 8.8 (2005): 911-927.

81 The organic layer in aerated (vs. water logged) conditions may consist of one or more of the following organic subhorizons: litter (OL), fragmentation horizon (OF) and/or humus (OH) (UNECE 2020). IPCC (2006) distinguishes 5 terrestrial carbon pools, among them 'litter' and 'soil'. Countries allocate carbon stocks differently to these pools: in some cases, OF and OH horizons are reported under the 'soil' pool, in other cases part of 'litter'. In some cases, litter (defined fine woody debris, dead leaves and needles in the OL horizon) is part of the 'dead wood' pool. Several countries assume certain pools are not changing, thus do not report; in other cases, global default values are use, in others country-specific data.

82 In forest soils, a subdivision of topsoil sampling depths is advisable. Also, ICP Forests soil sampling foresees monitoring below 30, because some SOC lost from the topsoil may be found at lower depths.

83 it is also not mandatory in the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) manual

Countries have conducted two consecutive forest soil surveys in a European sampling grid, called ICP Forests Level I (the second survey has been conducted in the BioSoil project under the Forest Focus Regulation). National surveys were conducted 1986-1996, and 2004-2008. The primary objective of the BioSoil project was to improved member states' UNFCCC reporting.

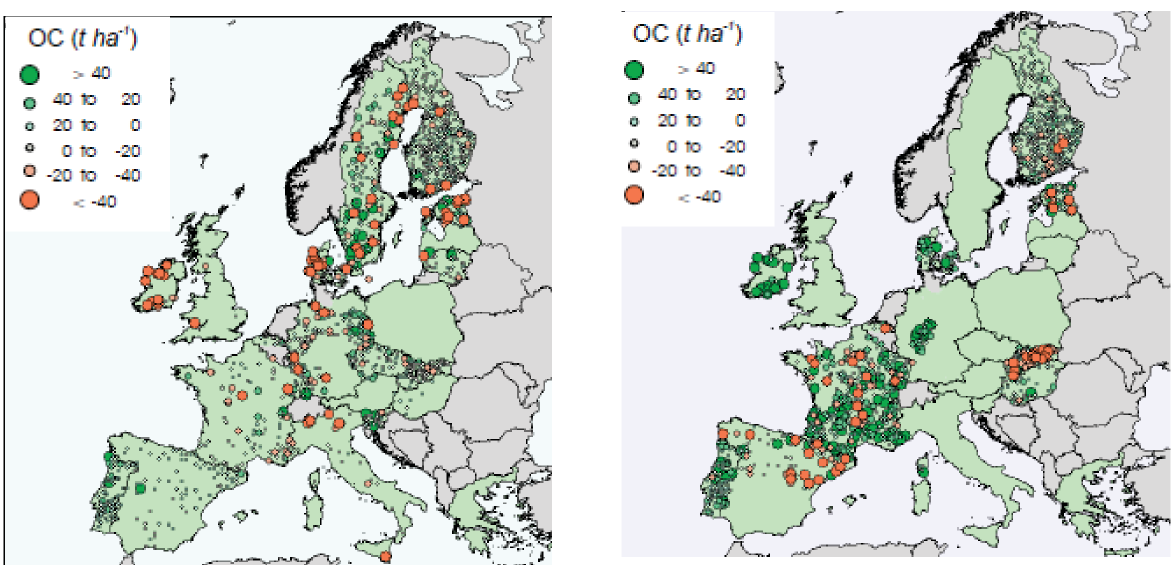
A subsample of the ICP Forests soil monitoring is used to report under the NEC Directive Art 9, and a monitoring exchange mechanism has been established.

Considering also the developments of LUCAS Soil (see below) and the continued discussion in the ICP Forests Soil Expert Panel, in conclusion, countries are prepared to engage in further forest soil surveys while they have continued to improve their survey manuals and analytical comparability.

Time series:

- Multidate data are available based on LUCAS Soil and the UNECE ICP Forests Programme.
- LUCAS data are field observations of forest topsoils (0-20 cm, starting 2022: 0-30 cm), which are collected every 3-4 years for all Member States.
- Data exist for 2009, 2015 and 2018.
- The next LUCAS sampling will take place in 2022 has been designed to provide statistically robust assessments of soil carbon stocks for forests at NUTS 0 Level.

Figure III-7 - Change in organic carbon stock between 1996 and 2006 (t ha-1): organic layers OF+OH (left) and mineral soil 0-20 cm. Source: Hiederer 2011



Proposal for a period of assessment:

Changes of SOC stocks in the mineral soil are generally slow with significant change expected over a decade. Robust evidence exists to show that forest management practices have an impact (both positive and negative on SOC stocks). This means that a 'proxy indicator' could be used to show potential change based on the adoption of specific practices on a more frequent basis but a LUCAS-style verification campaign should be considered every 10 years.

Improvements of the UNFCCC reporting towards the so-called Tier 3 quality standard, and considering developments in research and monitoring, soil modelling in combination with field surveys seem to be very successful in order to extrapolate between longer return intervals of field sampling. Modelling also allows to connect data from sampling grids to management practices.

Use and references of this indicator:
LULUCF, UNFCCC, SDG, Forest Europe, ICP Forests, to some degree also for Member States to report on NEC Art. 9.

Common Forest Bird indicator

Background

The association between avifauna and the ecological condition of ecosystems, and biodiversity, is described in a robust body of scientific evidence[84].

Declines in global biodiversity levels are the result of the interactions of pressures with the multifaceted nature of biodiversity. Different indicators describe different dimensions of biodiversity. This further increases the need for extensive biota data for monitoring, which in this case can support annual tracking of changes as well as long-term monitoring of common forest birds.

Common forest birds are proxies of the ecological condition and extent of forest ecosystems. Monitoring is a critical requirement in assessing the environmental policy process and effectiveness of various conservation measures.

- The abundance of species at a local scale in forests is largely dependent on the local forest structures[85,86,87]. However, the surrounding landscape may influence the local abundance of the species, due to e.g. spill-over of individuals from neighbouring patches[88].
- The patchiness of a specific habitat type in the landscape influences the distribution of a given species[89,90], and eventually, the species diversity of a given site[91,92].

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[84] https://pecbms.info/use-of-the-results/publications
[85] Balestrieri, Rosario, et al. "A guild-based approach to assessing the influence of beech forest structure on bird communities." Forest Ecology and Management 356 (2015): 216-223.
[86] Czeszczewik, Dorota, et al. "Effects of forest management on bird assemblages in the Bialowieza Forest, Poland." iForest-Biogeosciences and Forestry 8.3 (2015): 377.
[87] Díaz, Iván A., et al. "Linking forest structure and composition: avian diversity in successional forests of Chiloé Island, Chile." Biological conservation 123.1 (2005): 91-101.
[88] Ludwig, Martin, et al. "Landscape-moderated bird nest predation in hedges and forest edges." Acta Oecologica 45 (2012): 50-56.
[89] Basile, Marco, et al. "Patchiness of forest landscape can predict species distribution better than abundance: the case of a forest-dwelling passerine, the short-toed treecreeper, in central Italy." PeerJ 4 (2016): e2398.
[90] Hofmeister, Jeňýk, et al. "Spatial distribution of bird communities in small forest fragments in central Europe in relation to distance to the forest edge, fragment size and type of forest." Forest Ecology and Management 401 (2017): 255-263.
[91] Koivula, Matti J., et al. "Breeding bird species diversity across gradients of land use from forest to agriculture in Europe." Ecography 41.8 (2018): 1331-1344.
[92] Roth, Roland R. "Spatial heterogeneity and bird species diversity." Ecology 57.4 (1976): 773-782.

- The landscape context can also influence the relative abundance of specialist and generalist species, altering species composition[93]. The amount of habitat in the landscape may affect species composition, as species have different habitat requirements, especially in relation to habitat area[94].
- A reduced habitat area means also an increase in edge-area ratio with potentially negative consequences – generally referred to as 'edge effects' - for habitat specialist bird populations[95,96]. In contrast, in forested areas, open habitat, edge and early-successional species might take advantage of altered habitats, depending on their traits[97,98].

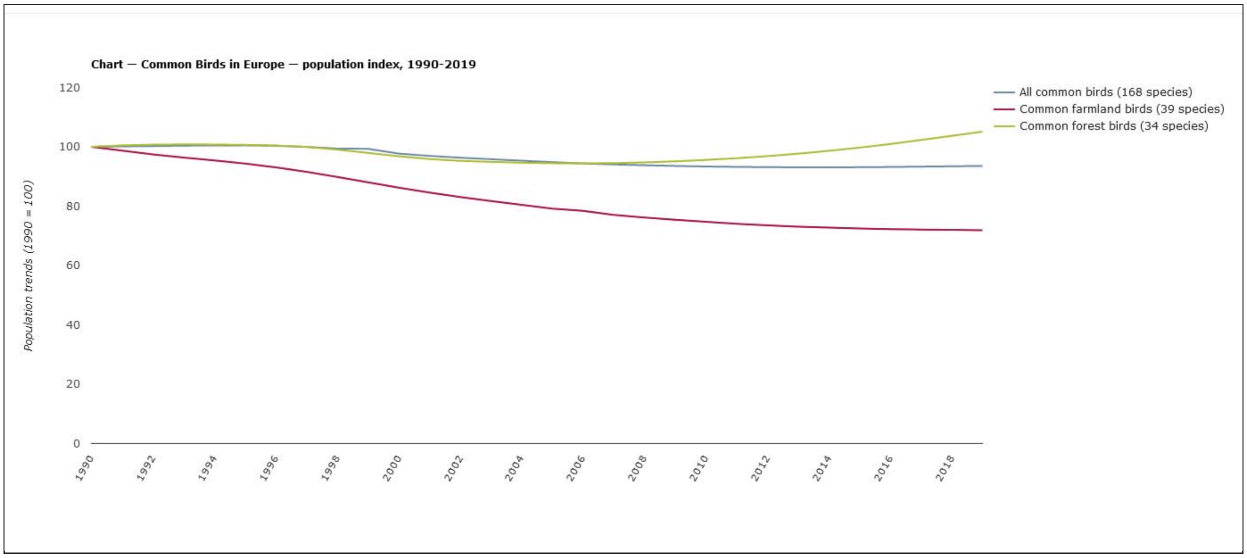
According to European Bird Census Council[99] (EBCC), there are some likely drivers explaining changes in the forest bird indicator. There is growing evidence that specialist species' populations decline at faster rates compared to generalist species due to land-use change and habitat degradation[100]. The declines observed in some EU regions, specifically in North and South Europe, could be the result of changes in forest area, forest composition, forest age and structure. These factors influence bird community composition and species trends, both positively and negatively depending on the species[101,102]. There is evidence that some forest specialists, particularly birds associated with old-growth stands, have declined and are threatened by intensive forest use.

Indicators on common forest birds from PECBMS are used in many EU policy initiatives, some examples are in available on the EBCC website[103].

Between 1990 and 2019, there was a decrease of 14% in the index of common birds across the 25 EU Member States with bird population monitoring schemes. The common forest bird index decreased by 5% in the EU[104]

Figure III-8: Common birds in Europe – population index, 1990-2019. Source: EEA

[93] Uezu, Alexandre, and Jean Paul Metzger. "Vanishing bird species in the Atlantic Forest: relative importance of landscape configuration, forest structure and species characteristics." Biodiversity and Conservation 20.14 (2011): 3627-3643.
[94] Devictor, Vincent, Romain Julliard, and Frédéric Jiguet. "Distribution of specialist and generalist species along spatial gradients of habitat disturbance and fragmentation." Oikos 117.4 (2008): 507-514.
[95] Andren, Henrik, and Per Angelstam. "Elevated predation rates as an edge effect in habitat islands: experimental evidence." Ecology 69.2 (1988): 544-547.
[96] Donovan, Therese M., et al. "Variation in local-scale edge effects: mechanisms and landscape context." Ecology 78.7 (1997): 2064-2075.
[97] Borchtchevski, Vladimir G., et al. "Does fragmentation by logging reduce grouse reproductive success in boreal forests?." Wildlife biology 9.4 (2003): 275-282.
[98] Jasińska, Karolina D., et al. "Linking habitat composition, local population densities and traffic characteristics to spatial patterns of ungulate-train collisions." Journal of Applied Ecology 56.12 (2019): 2630-2640.
[99] https://www.ebcc.info/
[100] Filippi-Codaccioni, Ondine, et al. "Toward more concern for specialisation and less for species diversity in conserving farmland biodiversity." Biological Conservation 143.6 (2010): 1493-1500.
[101] Gregory, Richard D., et al. "Population trends of widespread woodland birds in Europe." Ibis 149 (2007): 78-97.
[102] Gregory, Richard D., et al. "An analysis of trends, uncertainty and species selection shows contrasting trends of widespread forest and farmland birds in Europe." Ecological Indicators 103 (2019): 676-687.
[103] https://pecbms.info/use-of-the-results/policy/
[104] EEA, Chart — Common Birds in Europe — population index, 1990-2019. https://www.eea.europa.eu/data-and-maps/daviz/common-birds-in-europe-population#tab-chart_1



Description:

This indicator shows trends in the abundance of common forest birds[105] across their European ranges over time. It is a composite index created from data of bird species characteristic for forest habitats in Europe.

Source:

The indicator is provided by the Pan-European Common Bird Monitoring Scheme[106], which is a joint initiative of EBCC and BirdLife International.
The main aim of PECBMS is to use common birds as indicators of the general state of nature using large-scale and long-term monitoring data on changes in breeding populations across Europe.

PECBMS has developed statistical methods to calculate supranational, multi-species indices using population data from national annual breeding bird surveys in Europe[107,108]. Skilled volunteers using standardized field methods undertake data collection where methods and survey designs differ slightly across countries. Survey plots tend to be widely distributed at a national level, covering many bird species and habitats with reasonable representation. National species' indices are calculated using log-linear regression, which allows for plot turnover. Supranational species' indices are constructed by combining the national species' indices weighted by the national population sizes of each species. Supranational, multi-species indicators are calculated by averaging the resulting indices.

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[105] The list of birds species in the Common forest bird indicator:
Accipiter nisus ; Anthus trivialis ; Bombycilla garrulus ; Bonasa bonasia ; Carduelis citrinella ; Certhia brachydactyla ; Certhia familiaris ; Coccothraustes coccothraustes ; Columba oenas; Cyanopica cyanus; Dryobates minor; Dryocopus martius; Emberiza rustica; Ficedula albicollis; Ficedula hypoleuca; Garrulus glandarius; Leiopicus medius; Lophophanes cristatus; Nucifraga caryocatactes; Periparus ater; Phoenicurus phoenicurus; Phylloscopus bonelli ; Phylloscopus collybita ; Phylloscopus sibilatrix ; Picus canus ; Poecile montanus ; Poecile palustris ; Pyrrhula pyrrhula ; Regulus ignicapilla ; Regulus regulus ; Sitta europaea ; Spinus spinus ; Tringa ochropus ; Turdus viscivorus.

[106] PECBMS https://pecbms.info/

[107] Gregory, Richard D., et al. "Developing indicators for European birds." Philosophical Transactions of the Royal Society B: Biological Sciences 360.1454 (2005): 269-288.

[108] Devictor, Vincent, et al. "Differences in the climatic debts of birds and butterflies at a continental scale." Nature climate change 2.2 (2012): 121-124.

These indices support EU biodiversity targets across national, regional, and European spatial scales[109,110], and can be used to monitor the effects of management practices on bird species[111,112].

Forest habitats differ across the European regions as well as the bird communities there. Therefore, the indicator is also produced at a regional (supranational) level and different regions show different trends of their respective common forest birds. It is recommended to use region/national specific species selection for the forest bird indicator to better reflect the differences between regions and countries.

To be noted, that a current work[113] is carried out to fine-tune the selection of species that will contribute to the indicator.

Time series:
A value of 100 is set for each species in the first year of the time series. The time-series covers the period 1980-2019, though it is usually assessed from 1990.

PECBMS produces European and EU indicators with 2-year delay. So, the 2021 update is based on data covering the period 1980–2019. Data for the current year are updated from the data provided by the MS in year N-2.

However, the individual MS vary in national forest bird indicators production – some may publish the data until the current year already in the end of the given year. In near future, PECBMS aims to speed up the European indicators production, to 1-year delay.

Overall analysis of the indicators

A. Environmental impacts

Age structure - share of uneven-aged structure

Uneven-aged forests exhibit more structural diversity. In turn, structural diversity of forest is typically associated with higher levels of biodiversity, enhanced services and tree productivity, with research showing the positive effects of structural diversity on forest productivity and ecosystem dynamics[114].

The variety of stand strata allows the multiplication of habitats for a wide variety of species. It can be appreciated in a horizontal dimension (juxtaposition of homogeneous patches of vegetation) or

[109] EEA 2012
[110] Fraixedas, Sara, et al. "A state-of-the-art review on birds as indicators of biodiversity: Advances, challenges, and future directions." Ecological Indicators 118 (2020): 106728.
[111] Tisseuil, Clément, et al. "Strengthening the link between climate, hydrological and species distribution modeling to assess the impacts of climate change on freshwater biodiversity." Science of the total environment 424 (2012): 193-201.
[112] Gamero, Anna, et al. "Tracking progress toward EU biodiversity strategy targets: EU policy effects in preserving its common farmland birds." *Conservation Letters* 10.4 (2017): 395-402.
[113] quantifying species' association with and degree of specialization for different habitat types: technical and scientific support in relation to the delivery and development of wild bird indicators for the EU
[114] Dănescu, Adrian, Axel T. Albrecht, and Jürgen Bauhus. "Structural diversity promotes productivity of mixed, uneven-aged forests in southwestern Germany." Oecologia 182.2 (2016): 319-333. https://link.springer.com/article/10.1007/s00442-016-3623-4

vertical dimension (superimposition of vegetation strata of different sizes, also called "stratification").

Stratification is a crucial component of the habitat of forest species. The diversity of structures on a fine scale allows, on the one hand, the accommodation of a great diversity of species with varied requirements due to the juxtaposition and superimposition of different strata, and on the other hand, facilitates recolonization by species with low dispersal capacity, due to the proximity of similar strata.

Forest connectivity

Spatially explicit maps of forest connectivity are key elements for the assessment of forest biodiversity, habitat quality and ecosystem integrity.

- Forests and woody vegetation in other wooded land, thanks to their longevity, structural complexity and special microclimate, represent habitat for many plant and animal species. Often diversified vertical structure and plant species mixture form an environment for the survival of diverse animal species.
- Forests and woody vegetation formations form stabilizing landscape elements, especially in highly populated areas characterized by intensively managed anthropic landscape features with limited conditions for survival of many species.

The overall interest to manage land in a sustainable manner has led to the development of regional concept of SFM within MCPFE process[115]. Implementation of SFM is monitored by a set of regularly revised indicators for SFM, covering relevant issues of sustainability in forest management.

Moreover, locating and quantifying changes in forest connectivity allows for monitoring progress in policy directives (NRL, 8EAP, Green Deal, Biodiversity Strategy, Forest Strategy, 3 billion trees, SDG15 “Life on Land”) and improving forest ecosystem health by mitigating forest risks.

Tree cover density

Tree cover density is a synthetic indicator describing changes in the structure of forest ecosystems. Which in turn affect the delivery of key ecosystem services, including habitat for biodiversity, climate regulation, carbon storage and water supply, among other.

Continued tree cover loss over time will likely result in forest degradation and fragmentation. In addition, it is desirable that tree cover losses should be minor, or at least equal, than gains in the long term in order not to decrease the area covered by trees. Similarly, a large turnover of gain and losses will result in young forest stands unable to provide yet the full range of ecosystems services.

Consistent wall-to-wall information of tree cover density is useful for early detection of degradation trends. The baseline data of this indicator is updated every 3 years, which is a

[115] FOREST EUROPE 2019. Pilot study: Forest Fragmentation Indicator, by Raši, R. & Schwarz, M., Liaison Unit Bratislava, Zvolen, 2019 https://foresteurope.org/wp-content/uploads/2016/08/Pilot-study-Fragmentation.pdf

frequency higher than that of the information provided by National Forest Inventories (usually every five years).

In the environmental perspective:

- Increasing tree cover density in degraded or disturbed forest will result in improving overall ecological condition. Thus restabilising forest services and appropriate biodiversity levels.
- a healthy forest is one that is in a succession stage at which trees' canopy is multi-layered and uneven-aged (see age –structure indicator); the forest is a combination of large living trees as well as decayed trees that provide a fundamental habitat for animals and micro-organisms[116]. These features are often observed in forest with high structural, functional and compositional diversity, that is, forest approaching an optimum ecological state.

The density of trees is a key trait of the structural configuration of forests. Tree cover density is associated with high levels of biomass, ecosystem productivity, soil protection, carbon sinks and other ecosystem functions. Maintaining appropriate levels of tree cover density is key for forest with a robust structural component, which can underpin functional and compositional traits at adequate levels. In contrast, a persistent reduction of tree cover density over long periods might be associated with overuse, tree defoliation and mortality, the effects of climate change-induced drought or other degrading processes.

Monitoring tree cover density periodically offers the possibility of tracking changes at local level, but also and more importantly, at forest and landscape level, where major degrading macro-processes can be detected using remote sensing technology.

Other references are available on tree cover density[117].

Dead wood

The volume of deadwood in intensively managed forests is under 10% of that in comparable types of natural forests[118]. Forest-dependent insects, mammals, non-vascular plants and breeding birds are heavily affected by an excessive removal of dead and old trees or the reduction of old-growth forests.

A meta study summarising the characteristics and results of 37 studies investigating threshold values of the occurrence or number of species in relation to dead-wood volume has been conducted on dead-wood threshold data from European forests and revealed 36 critical values with ranges of 10–80 m3/ ha for boreal and lowland forests and 10–150 m3 ha-1 for mixed-montane forests, with peak values at 20–30 m3 /ha for boreal coniferous forests, 30–40 m3/ ha for mixed montane forests, and 30–50 m3 /ha for lowland oak–beech forests.

Recommendation regarding dead wood threshold to make current wood-production practices in beech forests throughout Europe more conservation oriented (i.e., promoting biodiversity and ecosystem functioning): on the basis of studies' results , recommendations lead to increasing the

[116] Kimmins, James Peter. "Forest ecology." *Fishes and forestry: Worldwide watershed interactions and management* (2004): 17-43.
[117] Ibid 99
[118] Stokland, Jogeir N., Juha Siitonen, and Bengt Gunnar Jonsson. *Biodiversity in dead wood*. Cambridge university press, 2012.

amount of dead wood to >20 m3/ha; not removing dead wood of large diameter (50 cm) and allowing more dead wood in advanced stages of decomposition to develop and designating strict forest reserves, with their exceptionally high amounts of dead wood, that would serve as refuges for and sources of saproxylic habitat specialists.

Soil organic carbon in forest - SOC

Overall: the current levels of SOC in mineral soils are lowered (degraded) as a result of many forest operations/sylviculture. Mayer et al (2020)[119] showed that:

- Afforestation of former croplands increases soil C stocks, but stocks are unchanged or reduced in former grasslands and peatlands.
- Removal of biomass through harvesting, herbivory or removal of residue or fuelwood reduce soil C stocks, in accordance with the intensity of removal.
- Nitrogen addition through fertilization or inclusion of N-fixing plants consistently increases soil C stocks across a wide range of forest ecosystems.
- Tree species identity has a stronger impact on soil C stocks than tree species diversity.
- Stand density management and thinning have small effects on forest soil C stocks.
- Often artificially thick forest floors have been built. This soil carbon pool is very sensitive to climate change and other disturbances (e.g. fires).

Restorative forest management has the objective to transform current plantations towards nature-close, stable and resilient forests – with the effect that SOC in the mineral soil increases (increased root biomass and turnover in the mineral soils (less rooting in the forest floor), while decomposition occurs in the mineral soil rather than in the forest floor – leading to thinner litter layers thus less carbon stored in them (improved humus forms indicate improved soil biological activity).

The protective role of forest soils needs to be expanded to soils at risk of instability (steep shallow mountain soils, river plains, coastal soils and dunes, organic soils under agricultural management, but also peat protection (conservation function of forested wetlands).

Targeted and continued sustainable soil management practices can significantly help in achieving climate neutrality by increasing the carbon stocked in mineral soils. Achieving net-zero greenhouse gas emissions by 2050 relies also on carbon removals through the restoration and better management of soils to store the atmospheric CO2. Healthy forest soils will also make the EU more resilient to weather extremes and reduce its vulnerability to climate change (e.g. increased water retention reduces food peaks while mitigating drought conditions).

The banking and financial sector is increasingly interested in investing in those land owners who apply sustainable practices and increase soil carbon, as well as creating market-based incentives for carbon storage. There is evidence that carbon farming (agro-forestry and forestry) can contribute significantly to the EU’s efforts to tackle climate change but also brings other co-benefits such as increased biodiversity and the preservation of ecosystems.

[119] Mayer, Mathias, et al. "Tamm Review: Influence of forest management activities on soil organic carbon stocks: A knowledge synthesis." *Forest Ecology and Management* 466 (2020): 118127.

Given the crucial role of soil in the water cycle, it is also indispensable for climate adaptation. A high water retention capacity in soils reduces the effects of flood peaks and decreases the negative impact of droughts. Carbon content in soil is to a large extent a biological process so it is not surprising that higher levels of (retention is conditioned by soil texture). Increased soil carbon levels in mineral improves soil condition by supporting aggregate formation that in turn improves soil structure, a key factor that governs water and gas movement within soils as well as providing an improved habitat for soil organisms. In parallel, increased levels of organic matter provide the energy sources for soil-dwelling organisms, and thus underpinning the soil-food web, which in turn, is linked to higher soil biodiversity levels.

B. Socio-Economic Impacts

A short analysis of the different socio-economic impacts has been carried out for the following indicators:

Age structure - share of uneven-aged structure:
Changes in forest management practices oriented to increase the share of uneven-aged forests may have effects on wood production. For instance, more intense forest management approaches would have to face a reduction in the area of even-aged stands, which can influence forestry decisions and wood production. This suggests in practice a shift from more intense forest management approaches to less intense approaches e.g. close-to-nature forestry, which often uses un-even aged stands in the wood production management.

An increased share of un-even aged stands would result in a richer structural diversity, which with time and appropriate management will result in forests with more compositional and functional diversity, hence in an improved forest condition. However, there might be a trade-off between wood production versus good ecological condition, richer biodiversity and other ecosystem services.

In sustainable forestry, forests should produce multiple ecosystem services for society, such as timber, carbon sequestration and biodiversity. Therefore, in the evaluation of forest management strategies, we have to consider the impacts of management on several ecosystem services. A recent study[120] compared the effects of five different forest management strategies on timber drain, carbon stocks, carbon balance and biodiversity indicators, while maximising economic revenues from timber production. The assessment was carried out in a boreal landscape of 43 000 ha over a 100-year calculation period and supports the finding that any-aged (forest management in which no explicit choice is made between even- and uneven-aged management) and continuous cover forestry is best in terms of carbon sequestration and biodiversity indicators. In general, management strategies that used thinning from above and that were not restricted to rotation forest management as the only option provided more ecosystem services and were also economically profitable.

A clear conclusion from this study is that more varied management strategies that include the combined use of continuous cover and rotation forestry have a greater potential to produce

[120] Díaz-Yáñez, O., Pukkala, T., Packalen, P. and Peltola, H., 2019. Multifunctional comparison of different management strategies in boreal forests. Forestry: An International Journal of Forest Research

simultaneously multiple benefits from forests at the landscape level, while still being economically profitable. In this sense, it is important to diversify management strategies in order to satisfy the increasing and variable future demands for multiple forest use

Dead wood

The cost of deadwood enrichment strategy (and integrative management approach) management can be determined from reduced revenue and additional expenditures.

The case study of the Ebrach Forest[121] - Germany - shows that these approaches do not radically change overall economic viability, since many measures of benefit ecologically also economic benefits. Overall the Erbrach study shows that a forest deadwood enrichment strategy by only harvesting sawn wood (and to a minor degree industrial timber) and leaving the complete tree crowns on site can be economically efficient. This case study can serve as a good practice example for integrative forest management where biodiversity conservation, timber production, and many other ecosystem services are managed in an optimised way. Considering the scenarios of increasing pressure on wood resources in Europe because of increasing wood demand, it is crucial to ensure that quality and efficiency of biodiversity enhancement in forest management is equally given priority, and these studies show that this is economically feasible.

Furthermore, a further a more recent study conducted in Ebrach's forest showed that the Total Economic Value (TEV) provided by all ecosystem services far exceeds the income from timber[122]: on average, an annual profit of approximately € 1 million is generated from forest management. Around 67 €/ m³ is the average income from timber. This underlines the multi-benefit management of forests has even further economic potential.

Conclusions on indicators

The purpose has been to examine and justify what indicators that demonstrate the enhancement of biodiversity in forest ecosystems could be considered for inclusion in the legal proposal. To this end, a number of potential indicators were first identified and a set of criteria were developed to select the most promising. From the original broad set of indicators a set of six were identified as the most adequate. This was followed by an assessment of the environmental and socio-economic impacts that increases in some of these indicators would entail.

The indicators selected and analysed each constitute different ways of representing the enhancement of biodiversity in forests ecosystems. They focus on either on key indicator species (such as forest birds) or aspects of the habitats themselves (such as the age structure of a forest, or presence of deadwood) and are the most frequently used tool to monitor the status of biodiversity, changes to biodiversity, and the effects of management actions. In this way, together, the indicators provide complementary information on the presence of biodiversity in relation to the forest structural diversity, habitat provisioning, and forest matrix connectivity.

[121] U. Mergner1, D. Kraus - Ebrach – Learning from nature: Integrative forest management

[122] Stößel, Laura, et al. "Analysing wind and biomass electricity potential in rural Germany considering local demand in 15-minute intervals." *Wind Energy Science Discussions* (2019): 1-16.

The increased ecological benefits also entail the improvement of the delivery of a range of forest ecosystem services, a number of which can contribute to direct economic benefits. An assessment by EUROSTAT of the value of ecosystem services of forest in good ecological condition indicates that the value of only four ecosystem services (carbon sequestration, flood control, water purification and nature-based recreation)[123] is 4.5 times the value of timber provision). Moreover, based on annually updated work from the Office for National Statistics (ONS), UK the annual value of woodland ecosystem services in England is estimated to be £1.6 billion in 2017, representing *50%* of the annual value for UK woodlands as a whole[124]. The ecosystem services included carbon sequestration, pollution removal, noise reduction and recreational and cultural services. To provide such services effectively forest ecosystems need to be in good health. Furthermore, some of the other studies in the previous section showed that showed that multiple-service benefit forest management is economically feasible, and in the future may have even more economic potential. Thus, increases in the values of the set of indicators considered in this analysis would also would have the effect of providing a range of socio-economic benefits associated with these forest ecosystem services.

In summary, the indicators considered in this assessment, such as forest birds or dead wood or tree density, provide a robust set of indicators that describe biodiversity in forests ecosystems in a holistic and complementary manner. Overall, there is evidence to conclude that introducing an obligation for Member States to provide evidence of increasing trends for the set of indicators analysed, that describe enhancement of biodiversity, would provide overall benefits to the environment, society and the economy.

[123] European Commission, Measuring what ecosystems do for us: new report on ecosystem services in the EU, 2021 https://ec.europa.eu/environment/news/measuring-what-ecosystems-do-us-new-report-ecosystem-services-eu-2021-06-25_en

[124] UK Office for National Statistics: Overall quantity and value of UK woodland https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/woodlandnaturalcapitalaccountsuk/ecosystemservicesforenglandscotlandwalesandnorthernireland2020#overall-quantity-and-value-of-uk-woodland

4. Agro-ecosystems

4.1 Scope

Agro-ecosystems include all grasslands and some other seminatural habitats that are usually grazed by livestock and/or used for other agricultural / silvi-cultural purposes, as well as all croplands including arable, vegetable, fruit and other permanent crops. These ecosystems are divided into the following:

- **Natural and semi-natural agricultural habitats (many of which are listed in Annex I of the Habitats Directive)**
    - Natural habitats: permanent grasslands, shrublands and other habitats that are extensively grazed, but are not dependent on grazing for maintenance and have not been significantly changed by livestock grazing or other human activities.
    - Semi-natural habitats: vegetation and associated species that have not been planted and are dominated by native species, but are the result of human activities, for example woodland clearance, grazing and burning. These include:
        - Grassland and shrubland pastures that are dependent on livestock grazing for their maintenance; and
        - Meadows that are dependent on mowing (usually for hay) for their maintenance, although they may also be grazed at some times of year.
- **Agriculturally improved grasslands and croplands**
    - Agriculturally improved grasslands, which have been modified to increase their agricultural productivity such as through drainage, use of artificial fertilizers, and ploughing and reseeding.
    - Cultivated croplands, including ploughed and sown artificial temporary grasslands which are often converted from permanent grasslands. Most cultivated and permanent croplands in Europe are currently intensively managed, but some extensive cereals (for example on poor soils, dry, saline or waterlogged areas, or in remote locations) and old traditionally managed orchards have semi-natural elements and are richer in biodiversity.

Natural and semi-natural agro-ecosystems include 35 Habitats Directive (HD) Annex I habitat types, hereafter referred to as HD Annex I agricultural habitats. These 35 HD Annex I agricultural habitat types cover close to **177 442 km^2** (**4.5 %** of the EU terrestrial area[125]); this excludes areas reported by Romania, which are known to be largely overestimated[126]. The area of natural and semi-natural agricultural habitats not covered by HD Annex I habitats is not known, as they have not been defined and mapped. According to Corine Land Cover data the total area of agro-ecosystems in the EU was 2 096 616 km^2 in 2018 (48 % of the EU terrestrial area). Whilst the Annex I data and Corine data are not directly comparable, they suggest that approximately **1.9 million km^2** are non-Annex I agricultural habitats. Although the exact proportion is not known, the vast majority comprises agriculturally improved grasslands and croplands.

[125] Area of habitats calculated from the area reported by Member States as 'best estimate' or 'average of minimum/maximum'.
[126] The average total area of agri-habitats and grasslands habitats reported by Romania is 54 124 km^2.

This impact assessment also considers EU protected species that are associated with the agro-ecosystems. These include 123 bird species that breed or winter in grasslands and croplands, and 328 species listed in the HD Annexes II, IV or V, for which grasslands or croplands are a preferred habitat.

In addition, actions are considered for **agricultural areas in addition to those covered by the Annex I habitats types under the Habitats Directive**; see section 4.6.

A target on **rewetting drained organic soils/peatland under agricultural use (both grasslands and cropland)** is considered and analysed in the section on **soils**.

Detailed data on the geographical distribution, area (km²), conservation status and condition of agricultural habitat types of Annex I of the Habitats Directive in EU Member States is provided in Annex VIII-c.

4.2 Problem, current trends and ecosystem-specific baseline

Natural and semi-natural agro-ecosystems are of very high biodiversity importance in the EU for several reasons. Firstly, some extensive pastoral systems and traditional agroforestry systems are of high conservation and scientific interest as to some extent they mimic natural grassland ecosystems that were formerly present in some regions and maintained by wild native herbivores. Many semi-natural ecosystems and associated landscapes are also highly species rich. As a result of their high biodiversity value, and because many are now scarce and/or declining, many natural and semi-natural agricultural habitats in the EU are listed in HD Annex I, and a high proportion of associated species are listed in HD Annex II or Birds Directive Annex I. More than a quarter of habitats of European importance depend either fully or partially on extensive agriculture, including numerous species of flora and fauna[127], such as farmland birds. Increasingly, the EU's Common Agricultural Policy incentivises extensive farming practices, as illustrated by the CAP indicators related to agroforestry[128].

In addition to their fundamental role in providing food, and other products, some agro-ecosystems, especially grasslands and pastoral woodlands, are important for several other ecosystem services. Of these, carbon sequestration and storage and water retention (providing water supply and flood alleviation benefits) are the most important. Others are related to semi-natural landscapes that are of considerable cultural, historic and aesthetic value, as well as to the opportunities for recreation, sport, science and education.

Now, HD Annex I agricultural semi-natural habitats, and associated species, are amongst the most threatened in the EU. Of these 35 habitat types, no dehesas or wood meadows were assessed as having a favourable conservation status in Member States' reports under Article 17 of the HD for the period 2013-2018. Only 8 % of assessments of agricultural heathlands and 11 % of grasslands assessments were reported as being in favourable conservation status. According to the Member

[127] Halada, L., Evans, D., Romão, C., and Petersen, J.E. (2011). Which habitats of European importance depend on agricultural practices? Biodiversity and Conservation 20, 2365- 2378.

[128] CAP Result Indicator R.17: Afforested land: Area supported for afforestation, agroforestry and restoration, including breakdowns and Output Indicator O.14a: Number of hectares or number of other units under maintenance commitments for afforestation and agroforestry.

States' reports on the condition (i.e. structure and function parameter) of their HD Annex I agricultural habitat types, 18 % of the habitats area was in not-good condition. However, the true area in not-good condition is uncertain, as 35 % of the total area of these habitats was reported as in 'unknown' (or not reported) condition. The true proportion of the area in a not-good condition is probably closer to the proportion of the area for which Member States reported on the condition of the habitat that had a not-good condition, which is 27 % [129]. The Article 17 reports have also revealed that most HD Annex I agricultural habitat types have declined in area over the twelve or so years up to 2018, despite over 43 % coverage within the Natura 2000 network. Not surprisingly, a high proportion of EU protected species that are dependent on HD Annex I agricultural habitats also has an unfavourable conservation status and declining trends. Furthermore, the trend in conservation status of the 35 Annex I agricultural habitats is showing that only 3% of the assessments have an improving trend and that 29% have a deteriorating one.

Whilst the extent of agriculturally improved grasslands and croplands is not declining, there is strong evidence that these habitats have a highly impoverished biodiversity. Monitoring studies also show that many species associated with agro-ecosystems are continuing to decline. For example, the Pan- European Common Bird Monitoring Scheme's common farmland bird index has documented an overall decline of 33 % between 1990 and 2017 at EU level.

The degradation of agro-ecosystems is also associated with soil carbon losses, soil erosion, soil compaction (causing water pollution, and accentuating floods), declines in pollinators and beneficial predators, and declines in landscape quality and public enjoyment of the countryside.

Two main pressures cause the degradation and associated declines in HD Annex I agricultural habitats: Land abandonment (sometimes followed by afforestation) and agricultural improvements and intensification, such as the ploughing of semi-natural grassland and heaths and conversion to improved grasslands. Some semi-natural grasslands have also been damaged because of eutrophication caused by the airborne deposition of nitrogen, mainly near areas with highly intensive livestock production. Within already agriculturally improved ecosystems, the main pressures are the result of past and ongoing agricultural intensification, specialisation and landscape simplification resulting in decreasing landscape features (hedgerows, tree lines, isolated trees, etc.). Other, non-agricultural pressures contributing to the degradation of agricultural habitats include urban expansion, invasive alien species, pollution from other sources than agriculture and climate change.

According to the review of evidence for the baseline assessment to 2030, there is little sign of change in most pressures (other than reductions in nitrogen pollution). Whilst the protection of HD Annex I habitats is expected to improve within Natura 2000 sites, there is little to indicate that this will also happen outside Natura 2000 sites. Furthermore, EU protected species outside the Natura 2000 network remain highly vulnerable, especially in intensively managed farmland landscapes. Much will depend on improved implementation of the Nature Directives in conjunction with how the new CAP will be implemented by the Member States and whether the anticipated increases in biodiversity funding will focus on the most important and effective measures for HD Annex I

[129] 115 330 km^2 with a reported condition, of which 31 180 km^2 had a 'not-good' condition.

habitats and protected species, including birds, in particular on tailored and targeted agri-environment interventions as well as effective eco-schemes.

Given these uncertainties, it is assumed under the baseline scenario to 2030 that the rates of loss of HD Annex I agricultural habitats and their degradation levels will not change significantly. Therefore, it is assumed that the loss of HD Annex I agricultural habitats will continue at 1.5 % per year and that in 2030 27 % of the HD Annex I agricultural habitat area will require restoration. Similarly, based on the evidence of pressures on agro-ecosystem species, a substantial proportion of the wider agro-ecosystems can be expected to continue to be degraded and requiring restoration.

4.3 Target options screened in/out

The following four broad objectives as a basis for targets setting are identified for agro-ecosystems, in order of priority in terms of their ability to provide biodiversity and ecosystem service benefits:

1. Maintain and restore HD Annex I agricultural habitats to good condition and ultimately favourable conservation status, and other natural and semi-natural habitats not listed in Annex I to good status.
2. Maintain and restore habitats for EU protected species that are predominantly associated with agro-ecosystems, including semi-natural habitats that are not HD Annex I agricultural habitats, and modified grasslands and croplands, such that they maintain and achieve a favourable / secure status.
3. Increase the proportion of agriculturally semi-improved and semi-natural habitats in the landscape, creating interconnected networks, buffering HD Annex I habitats, and aiming to restore some to HD Annex I habitats in the long-term.
4. Partially restore (i.e. enhance) agriculturally improved grasslands and croplands to increase their biodiversity beyond EU protected species and enhance ecosystem services, particularly in relation to climate mitigation and adaptation value.

Several options were considered for the achievement of these objectives, which are summarised together with the outcomes in Table IV-1. These were considered in the Biodiversity Strategy to 2030, including in relation to the target for **10 % coverage of landscape features** (e.g. including hedgerows and fallow) within farming landscapes. It was found that increasing the coverage of landscape features is a high priority, while recognising that the biodiversity value of landscape features is highly context specific and variable dependent on their quality. Basing the targets on HD Annex I agricultural habitats and EU protected species that are predominantly associated with agro-ecosystems is considered to be reliable way of presenting, achieving and measuring the desired outcomes. Such a target would also include the much-needed landscape features that are necessary to achieve improvements for the habitat types and species.

The most obvious aim of the target based on the EU protected species would be to achieve the sufficient habitats in terms of quantity and quality for the species concerned to reach favourable / secure status, as this would link directly to the objectives of the Birds and Habitats Directives, and its existing monitoring and reporting requirements. The target would complement the target based on HD Annex I habitats, as it would also cover the areas of semi-natural agricultural habitats not falling under HD Annex I definitions and standards.

There is also a strong argument for an additional complementary target because most of the HD listed species that are associated with agriculture are predominantly associated with HD Annex I habitats and other semi-natural habitats. Birds are much more widely distributed in agro-ecosystems, and restoration measures to secure their populations would provide wider benefits for agriculturally improved grasslands and croplands. Consequently, a target focused on restoring populations of common farmland birds that are typical of agriculturally improved grasslands and croplands would complement the overarching target for EU protected species, even though birds are already covered. The added value of the additional target would be that it would be more focussed on the established lists of common farmland species included in the Farmland Bird Index (FBI) at national level and a well-established and robust methodology that makes it ideally suited for target setting. A further advantage of adding a bird focused target for agriculturally improved grasslands and croplands is that birds are very good indicators of ecosystem condition as they are high in the food chain and occupy a range of ecological niches. Therefore, restoring their populations can be expected to contribute widely to restoring other species populations, as well as overall ecosystem quality and associated ecosystem services.

Two other options for targets were identified for further consideration: increasing semi-improved and semi-natural habitats in the landscape, and increasing old unploughed grasslands (permanent grassland) by halting ploughing and re-seeding of a proportion of agriculturally improved grasslands. The latter was selected as it is considered that it could provide significant biodiversity and ecosystem service benefits, whilst enabling continued sustainable agricultural production with limited economic costs and efficient monitoring and enforcement.

Table IV-1 Summary table screened target options

Target option	Screened in/out for assessment	Key reason(s) for screening in/out
1. Favourable conservation status of HD Annex I agricultural habitats	Included as primary goal of restoration target	This option provides a coherent measurable outcome target, which is considered coherent with environmental policy and feasible
2. Favourable conservation status of EU protected species predominantly associated with agro-ecosystems	Included	Provides a coherent measurable outcome target that supports and complements option1 and many EU protected species of agro-ecosystems
3. Increasing semi-improved and semi-natural vegetation in the farmland landscape	Included	Outcome focused and potentially measurable target that would complement options 1 and 2
4. Increasing landscape features in the farming landscape to a minimum coverage of 10 %	Not included as a target as such but further considered in more general terms, and an indicator.	Impractical basis for setting SMART target suitable for a legally binding instrument as such, but to be considered further in a different formulation, such as an indicator.
5. Halting the ploughing and reseeding of agriculturally improved grasslands over a certain proportion of landscape	Included	Although not outcome focused, this would be a practical measure that would provide significant benefits, including in terms of decreasing GHG emissions at low cost that can be easily monitored and enforced

Based on the above considerations, the impact assessment considered the following targets.

HD Annex I agricultural habitats

A) Restore all HD Annex I agricultural habitats to good condition, with all necessary restoration measures completed on 30 % (or 15 %) of degraded areas by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.

B) Recreate 30 % (or 15 %) of additional habitat area required to achieve Favourable Conservation Status (FCS) of HD Annex I agricultural habitats by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.

For target A), the area of HD Annex I agricultural habitat requiring restoration is that projected to have a not-good condition in 2030 according to the baseline scenario, which is 27 % of the habitat area (i.e. 47 909 km^2). For target B, according to Member States information on 'favourable reference areas' for their HD Annex I agricultural habitats, at least 2 431 km^2 would need to be re-created to achieve their FCS. However, the exact area required is uncertain as a significant proportion of Member States have not estimated favourable reference areas.

EU protected species associated with agro-ecosystems

C) Restore and recreate agro-ecosystems as necessary to:

1) increase the populations of **common farmland birds** as measured by the common farmland bird index in each Member State.

Examples have shown that wildlife-friendly farming practices, such as cutting hedgerows and ditches just once every three years and the creation of insect-rich and seed-rich habitats, have the capacity to not only reverse the decline in farmland birds but to produce a major increase, as measured by the Farmland Bird Index[130].

Since the starting points of Member States are very different, there is a need to differentiate among those Member States with historically depleted populations of farmland birds and the others.

In particular, the Member States with historically depleted populations of farmland birds are those where half or more species contributing to the national common farmland bird index has a negative long-term population trend. In Member States where information on long-term population trends is not available for some species, information on the European status of species is used.

The common bird monitoring data in Member States is not always available back to the 1980s. Thus, other sources of information have been used to fill the gaps. “Birds in Europe 2”[131] (BiE 2) and „Birds in Europe 3”[132] (BiE3) data sheets contain information on long-term trends (usually

[130] E.g. Hope Farm in East Cambridgeshire: https://www.rspb.org.uk/our-work/conservation/conservation-and-sustainability/farming/hope-farm/bird-numbers/

[131] Heath M., Borggreve C. and Peet N. 2000: European Bird Populations Estimates and Trends. BirdLife conservation series, no. 10. Cambridge, BirdLife International.

[132] Burfield I. J. and van Bommel F. (eds.) 2004: Birds in Europe Population Estimates, Trends and Conservation Status. BirdLife Conservation Series No 12. Cambridge, BirdLife International.

1980 to 2012) of species in individual countries and information on the species European status. Birds in Europe data is the same reported under Article 12 of the Birds Directive. Trends (in broad categories decline, stable, increase, fluctuating) correlate with the trends obtained by the common bird monitoring schemes. As the common bird monitoring data is often unavailable back to the 1980s, the same applies to some countries and species for BiE data. In such a situation, the information on the species population status in Europe, particularly whether a species is depleted, can be used as an additional piece of information. Thus, the Member States are selected using the following procedure: a long-term trend from BiE is used solely in Member States where more than half of species contributing to the national FBI has long-term trend known. In this group of countries, those where half or more species in the national FBI has the long-term trend negative (decline) are selected in Group 1 (Member States with historically depleted populations of farmland birds). The rest, i.e. countries where less than half of the species in FBI has a negative long-term trend, is selected in Group 2 (Member States that do not have historically depleted populations of farmland birds). Again, only species with known information on long-term trends are used for this assessment.

In case when the majority of species contributing to a national FBI in a country has the BiE long-term trend unknown, additional criteria are used for the assessment: a species classified as 'depleted' in BiE3 in Europe. Thus, if half or more species in a Member States has a long-term trend declining, or those with the unknown national trend are classified as depleted in Europe, the country is selected in Group 1. The rest is selected in Group 2.

Group 1: Member States with historically depleted populations of farmland birds would be Czechia, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Luxembourg, Netherlands, and Spain.

Group 2: Member States that do not have historically depleted populations of farmland birds would be Austria, Belgium, Bulgaria, Croatia, Cyprus, Greece, Ireland, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, and Sweden.

The target would therefore read:

Each Member State shall increase the populations of farmland birds as measured by the common farmland bird index re-set at 100 at year X [=one year after the entry into force of this Regulation] to:

(a) 110 by 2030, 120 by 2040 and 130 by 2050, for Member States with historically depleted populations of farmland birds;

(b) 105 by 2030, 110 by 2040 and 115 by 2050, for Member States that do not have historically depleted populations of farmland birds.

2) restore and re-create agro ecosystems as necessary to achieve the favourable conservation status of **species that are listed in Annex II, IV and V of the Habitats Directive** as well as all birds predominantly associated with agro-ecosystems, with 30 % (or 15 %) of all necessary actions carried out by 2030 and 60 % (or 40 %) by 2040 and 100 % 2050.

Semi-natural vegetation

D) Restore and recreate agriculturally semi-improved and semi-natural grassland [to be defined by selected plant indicators] on agriculturally improved grasslands and croplands for general biodiversity and ecosystems services, to replace losses since [1990, 2000, 2010] with 30 % (or 15 %) of losses replaced by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.

Increasing landscape features

See section 4.6

Restoration of old unploughed grasslands from agriculturally improved grasslands

E) Restore and recreate unploughed / untilled grassland for general biodiversity and ecosystems services on modified grasslands and croplands, to replace losses since [1990, 2000, 2010] with 30 % (or 15 %) of losses replaced by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.

4.4 Impacts of assessed target options

The costs of restoration of agro-ecosystems were estimated by calculating the area of degraded ecosystems to be restored and re-created annually to meet each target and applying average per hectare capital costs for restoration and re-creation, and annual costs for maintenance mainly taken from Tucker et al. [133] The costs of restoration and re-creation include the capital costs of actions such as restoration grazing/mowing, scrub removal, reseeding, hydrological works, soil fertility reduction and wildfire control. Annual maintenance costs include grazing management; mowing; maintenance of hedges, ditches, and other features; creation and maintenance of field margins, winter stubbles, fallows and cover crops; management of farm inputs; and appropriate cultivation, crop rotation and soil management practices. The required management will be undertaken largely by private landowners and land managers, in return for incentive payments, a large proportion of which include compensation for opportunity costs relating to land management (e.g. income forgone through reduced grazing, lower inputs and introduction of uncropped features on arable land). Maintenance costs were applied to the entire ecosystem area, since meeting the targets requires further degradation of ecosystems to be avoided.

Benefits estimates were based on an extensive review of literature of the value of benefits of agro-ecosystem restoration, which identified changes in per hectare values of ecosystem services for restored vs degraded ecosystems. The analysis applied estimates of the median per hectare value of carbon storage and sequestration values and total ecosystem service benefits of agro-ecosystem restoration derived from values obtained from more than 50 studies. Per hectare benefits estimates were applied to the area of ecosystem restored to give annual estimates of total benefits. Annual

[133] Tucker et al., (2013) Estimation of the financing needs to implement Target 2 of the EU Biodiversity Strategy. Report to the European Commission. Institute for European Environmental Policy, London. Available at: https://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/Fin%20Target%202.pdf

costs and benefits were estimated over the period 2022 -2070, recognising that, while restoration takes place to 2050, further maintenance costs continue beyond that date, while restored ecosystems continue to provide benefits into the future. Annual cost and benefit estimates were discounted, applying a 4% social discount rate, and summed to calculate their total present value. This enabled total net present value (benefits – costs) and benefit: cost ratios to be calculated.

The estimated costs of achieving good condition of HD Annex I agricultural habitats (target A) are summarised in Table IV-2. The costs are broadly based on the area of habitat that is in not-good condition or affected by specific pressures, multiplied by the costs of key measures to maintain the habitat and address pressures, thereby restoring the habitat, and to re-create habitat. The costs are additional to measures that are already in place. Also, to avoid double-counting, they do not include general supporting measures (e.g. creation of restoration plans), administration costs, or broad actions that apply to multiple ecosystems, such as the need to reduce nitrogen deposition below critical levels.

Table IV-2: Summary of projected costs (EUR) of achieving restoration targets for HD Annex I agricultural habitats in relation to current trends & expected 2030 baseline

Estimates do not include Romania as estimates of habitat extent are not available.

Targets 15 % and 40 %[134]

Period	% Full restoration	Maintenance costs	Restoration costs	Re-creation costs	Combined costs	Total over period
Average annual costs						
2022-2030	15 %	944 202 600	145 229 886	131 276 940	1 220 709 426	10 986 384 835
2031-2040	40 %	952 554 600	217 844 829	125 331 678	1 295 731 107	12 957 311 071
2041-2050	90 %[135]	966 474 600	435 689 658	127 018 728	1 529 182 986	15 291 829 863
Cost over full period (29 years)						
2022-2050	90 %	27 688 115 400	7 842 413 849	3 704 996 520	**39 235 525 769**	

Targets: 30 % and 60 %

Period	% Full restoration	Maintenance costs	Restoration costs	Re-creation costs	Combined costs	Total over period
Average annual costs						

[134] Although the 2050 target aims to restore 100 % of the habitat, the 2050 cost estimation is for 90 % restoration as this is the maximum percentage that can be expected in practice. Furthermore, an extrapolation of current restoration costs would no longer provide reliable estimates in the range between 90 and 100 %.

[135] Although the 2050 target aims to restore 100 % of the habitat, the 2050 cost estimation is for 90 % restoration as this is the maximum percentage that can be expected in practice. Furthermore, an extrapolation of current restoration costs would no longer provide reliable estimates in the range between 90 and 100 %. (See methodology section in SWD)

2022-2030	30 %	944 202 600	290 459 772	132 695 040	1 367 357 412	12 306 216 710
2031-2040	60 %	960 906 600	261 413 795	125 933 148	1 348 253 543	13 482 535 430
2041-2050	90 %[136]	977 610 600	261 413 795	125 933 148	1 364 957 543	13 649 575 430
Cost over full period (29 years)						
2022-2050	90 %	27 882 995 400	7 842 413 849	3 712 918 320	**39 438 327 569**	

Table IV-3 shows the projected costs of reversing the decline in common farmland birds (as included in the European farmland bird index) in each EU Member State, which includes key measures that would also contribute to reducing declines in pollinators and other farmland wildlife under target C. This is based on an adjusted extrapolation of the costs of a package of measures for birds, pollinators and other farmland wildlife in an agri-environment climate scheme in England. As this is the only study that has used detailed data from agri-environment schemes that have increased common farmland birds to quantify the area of habitat and scheme coverage needed to achieve farmland population increases, this has been used to estimate the costs for similar habitats and species in most EU countries. The per hectare unit costs of the package of measures were extrapolated according to the area of pasture and arable land in each country, and then adjusted to take account of differences in the trends in farmland bird populations and the costs of agri-environment measures. The estimates of the costs of target C for common farmland birds do not include Croatia, Italy, Portugal and Spain, due to their very different bird communities, and conservation requirements, which overlap more with those relating to HD Annex I agricultural habitats and BD Annex I bird species.

Table IV-3: Estimated annual costs of reversing declines of common farmland birds, and other key measures for wildlife in modified grasslands and croplands, as part of target C

	Pasture & heterogeneous land minus HNV land (km2)	Arable land minus HNV land (km2)	Min adjusted pasture & heterogeneous cost	Max adjusted pasture & heterogeneous cost	Min adjusted arable cost	Max adjusted arable cost	Min total cost	Max total cost
Total EU area	**316,123**	**805,134**	**96,119,467**	**170,057,519**	**497,024,782**	**753,553,702**	**593,144,249**	**923,611,220**

Min and max costs refer to the % coverage of the agricultural area with scheme agreements. Min pasture = 13 %, max = 23 %. Min arable = 31 %, max = 47 %. These are minimum and maximum estimates of the proportion of the landscape that need to be in schemes that provide 10 % of wildlife beneficial habitat (including agriculturally productive habitats) that would be required to

136 Although the 2050 target aims to restore 100 % of the habitat, the 2050 cost estimation is for 90 % restoration as this is the maximum percentage that can be expected in practice. Furthermore, an extrapolation of current restoration costs would no longer provide reliable estimates in the range between 90 and 100 %. (See methodology section in SWD)

increase the bird populations by 10 % by 2030. The minimum areas are where schemes focus on areas with high densities of the target species.

It would be expected that the achievement of favourable conservation status within HD Annex I agricultural habitats would also provide the required conditions for most associated EU protected species. Therefore, to avoid double counting, the habitat restoration costs for EU protected species were not estimated for HD Annex I agricultural habitats. Whilst some additional costs for species-specific measures would be expected, they would be a relatively small proportion of the total restoration costs (probably in the order of 10's of millions of euros). Relatively few HD Annex II, IV and V species are predominantly associated with agriculturally improved grasslands and croplands, and most of their restoration measures would be like those for birds and pollinators. Additional costs for these HD species would probably be relatively very low.

There was insufficient information available per unit area costs and area requiring restoration / re-creation to estimate the costs of restoring semi-improved and semi-natural vegetation (target D), and old unploughed grasslands (target E).

The costs of restoration action will be borne by farmers and land managers, who should in turn be compensated through agri-environment payments funded by taxpayers. Restoration actions will create employment and enhance incomes for farmers, farm workers and contractors.

Restoration of grasslands and agro-ecosystems will deliver substantial benefits for biodiversity, benefiting a wide range of European protected species. It will benefit society and the economy by enhancing the delivery of ecosystem services. These include provisioning services (especially by sustaining food production through sustainable agricultural practices), regulating services (climate, water quality, soil, flood management and pollination services) and cultural services (landscape, recreation and tourism, and benefits for non-visitors through knowledge that species and habitats are conserved). These services benefit the whole population, as well as specific sectors, especially agriculture, tourism and water sectors.

The ranges of per hectare values of benefits of restoration are summarised in Table IV-4. The source studies give wide ranges of estimates for restoration benefits. Here we identify the median values for each type of ecosystem restoration measure. Based on the evidence available, the estimated median values for grassland restoration are €172/ha/yr for carbon sequestration and storage, and €2,313/ha/yr in total for all ecosystem service values, the latter including a wide range of provisioning (food and fibre), regulating (e.g. water quality, flood management, pollination, soil quality, erosion control, climate regulation) and cultural services (recreation, landscape, aesthetic values) as well as benefits for biodiversity itself.

Insufficient evidence was found to enable monetary estimation of the benefits of cessation of ploughing of grasslands, restoring semi-natural vegetation or reversal of the decline of farmland birds and other wildlife. However, because the key restoration measures for these are like those required for the restoration of HD Annex I agricultural habitats, it can be reliably expected that they would result in substantial increases in ecosystem services and their associated economic and wider benefits.

Table IV-4: Summary of Benefits Estimates from the restoration of HD Annex I agricultural habitats (targets A and B)

Ecosystem	Service valued	Range (EUR/ha/year)	Median estimate (EUR/ha/year)
HD Annex I agricultural habitats	Carbon sequestration	172	172
	Multiple ecosystem services	43 – 5 112	2 313
Favourable / secure status of EU protected species & reversal of farmland bird & biodiversity declines	No monetary estimates available.		
Increasing semi-improved and semi-natural vegetation	No monetary estimates available.		
Cessation of ploughing of grasslands	No monetary estimates available.		

Monetary estimates of the value of the benefits of ecosystem restoration have been made by multiplying the per hectare values in the table above by the area of ecosystems restored and re-created. The benefit: cost analysis estimates that the total ecosystem service benefits of restoring HD Annex I habitats outweigh the costs by a ratio of 9 to 1 (Table IV-5). The carbon sequestration benefits alone are estimated at 60 % -70 % of the overall costs.

Table IV-5: Benefits and costs of restoration of Annex I agricultural habitats (Present value, 2022-2070, MEUR)

	15 % /40 % /90 % target	30 % /60 % /90 % target
COSTS		
Maintenance	20 381	20 452
Restoration – full recovery	3 999	4 594
Re-creation	2 179	2 186
TOTAL (full recovery)	**26 559**	**27 732**
BENEFITS (full recovery)		
Carbon only	17 073	18 624
Total Ecosystem Services	229 589	250 451
Net Present Value (full recovery)		
Carbon only	-9 486	-10 159
Total Ecosystem Services	203 030	223 220
Benefit: Cost Ratio (full recovery)		
Carbon only	0.6	0.7
Total Ecosystem Services	8.6	9.2

4.5 Synthesis

Table IV-6 provides a summary of the analysis of options and conclusions in relation to the effectiveness, efficiency, coherence, and proportionality of each target. The overall conclusion is that there are strong arguments for legally binding targets for achieving favourable conservation status of HD Annex I agricultural habitats, and for EU protected species associated with all agro-ecosystems. Whilst both targets overlap, they also complement each other to some extent. In particular, the EU protected species target extends the coverage of restoration measures to all agro-ecosystems, thereby contributing to wider benefits across the countryside and related ecosystem services. This is particularly the case as it includes all birds, which act as indicators of overall ecosystem condition, and provide indirect protection for a wide range of species that are not listed in the annexes of the Habitats Directive. Therefore, there is a logical argument for including both targets.

The targets for re-creating semi-improved and semi-natural vegetation, and old unploughed grassland, from improved grassland and cropland, would probably trigger effective restoration measures that further complement and support the proposed targets of Annex I agricultural habitats and EU protected species. However, the further development of criteria for assessing and monitoring the status of semi-improved and semi-natural vegetation in the landscape beyond that of Annex I habitats would be required to implement this target effectively and robustly. Further evidence is also required on its potential cost effectiveness, as the re-creation of these habitats can be costly and constrained by important factors such as high fertility levels in agricultural soils. Whilst the feasibility of restoring old unploughed grasslands is high, further evidence is required on its cost effectiveness, and potential overlaps with other similar objectives in relation to soil quality and water resource management.

Table IV-6: Overview table assessing options on EU impact assessment criteria

	Annex I habitats	Measures for protected species	Increasing semi-improved and semi-natural vegetation	Restoring old unploughed grassland
Feasibility / effectiveness	High feasibility and potential for restoration and re-creation (for most habitats), and effective at increasing biodiversity and ecosystem services	Moderate to high feasibility in most Annex I habitats; variable in improved agricultural areas due to numerous species and diverse factors affecting them.	High feasibility and potential for re-creation; and increasing biodiversity and ecosystem services, especially semi-natural vegetation	High feasibility and high effectiveness in increasing soil biodiversity and carbon, and related ecosystem services; some benefits for wider biodiversity
Efficiency	Substantial benefits for biodiversity and ecosystem services. Carbon benefits alone are estimated at 60-70 % of total costs; total ecosystem service benefits are estimated to outweigh costs by a ratio of 9:1.	Substantial benefits for biodiversity and people, including environmental regulating and cultural services, cannot be estimated in monetary terms.	Insufficient evidence available to quantify, but expected to provide significant benefits.	Insufficient evidence available to quantify, but expected to provide significant benefits. May have high cost-effectiveness, for ecosystem service benefits, but further evidence required.
Coherence	Full coherence with EU environmental policies and climate goals. Potential to make significant contributions to climate mitigation, and climate adaptation. Overlaps with species target	Full coherence with EU environmental policies and climate goals. May indirectly contribute to climate adaptation and mitigation. Overlaps with Annex I target and targets for pollinators (separate IA).	Full coherence with EU environmental policies and climate goals. Potential to make significant contributions to climate mitigation, and climate adaptation. Overlaps with Annex I and species targets.	Full coherence with EU environmental policies and climate goals. Potential to make significant contributions to climate mitigation, and climate adaptation. Could overlap with soils targets (separate IA)
Proportionality	High due to the very high importance of the	High for declining EU protected species in HD	High for increasing semi-natural habitats,	Probably high, due to expected relatively low

	habitats for biodiversity and associated ecosystem services	Annex I habitats, moderate in improved grasslands and croplands	moderate for semi-improved	opportunity costs – but needs further research
Conclusion	**Include as a target, with high priority**	**Include as a target, with high priority**	**Consider further, as a possible second stage target**	**Consider further as, a possible second stage target**

4.6 Agro-ecosystem indicators

General Introduction

Given the extensive evidence on the decline of biodiversity across many agro-ecosystems in the EU, options for action need to be considered for agricultural areas in addition to those covered by the Annex I habitats types under the Habitats Directive. Methods already exist to determine good condition of these habitat types and options for restoration targets for these were described in the previous sections. For habitat types or ecosystems not covered by the Habitats Directive, specific indicators can be used to provide evidence of enhancement of biodiversity.

This section therefore provides an assessment of introducing obligations for Member States to provide evidence of increasing trends for a set of indicators that describe enhancement of biodiversity in agroecosystems, in addition to those measures already described in previous sections for Annex I habitats. It should be noted that this assessment considers both the impacts that an indicator directly demonstrates (e.g. increase of butterfly populations per se) as well as the underlying costs and benefits of having healthier agro-ecosystems (as evidenced by having an increased butterfly populations).

Agroecosystems host some of the most species-rich habitats in the EU and it is estimated that roughly 50% of all species in Europe rely on agricultural habitats at least to some extent[137,138]. Healthy agroecosystems also provide safe, sustainable, nutritious and affordable food. However, the condition of agroecosystems has been suffering from long-term degradation and important biodiversity losses[139], while pressure levels are to a large degree unchanged or increasing (key drivers being climate change, land conversion, pollution and nutrient enrichment). As underlined in the Green Deal and the Biodiversity Strategy for 2030, the Union needs to improve the health and biodiversity of its agricultural lands.
Biodiversity losses are widespread and it is evident that efforts made so far need to be reinforced by restoration measures to be put into place in agricultural ecosystems in the EU, including in particular those not covered by the Annex I habitats types of the Habitats Directive. Therefore addressing the improvement in biodiversity even to some extent of these areas is clearly important, even if condition is not as yet defined. As mentioned in section 5.2, approximately **1.9 million**

[137] Halada, L., Evans, D., Romão, C., and Petersen, J.E. (2011). Which habitats of European importance depend on agricultural practices? Biodiversity and Conservation 20, 2365- 2378.
[138] Lomba1,et al, Back to the future: rethinking socioecological systems underlying high nature value farmlands. Frontiers in Ecology and the Environment, 2015.
[139] IPBES report in Europe and Asia, the ECA report on CAP and Biodiversity[Full References needed]

km² are non-Annex I agricultural habitats in the EU. Although the exact proportion is not known, the vast majority comprises agriculturally improved grasslands (i.e. pastures) and croplands.

For the initial stage in this analysis, a broad set of indicators were considered as a means of gauging the improvement of biodiversity in agroecosystems. Even though the methodology to define ecosystem condition for these ecosystems is not ready yet, evidence of an increasing trend in a set of indicators related to biodiversity would act as a proxy for improvement in biodiversity. This could thus constitute specific legal obligation of improvement of the indicators in the legal proposal.

The process of indicator selection is grounded on extensive work carried out over several years as part of the MAES[140] and the UNSEEA EA[141] standards that have been developing methodologies and indicators to assess the condition of all ecosystems. Part of these indicators concern agroecosystems condition (cropland, pasture, natural & semi-natural grassland), that are relevant, based on available data, repeatable through time, and ecologically meaningful in terms of ecosystem structure, function and composition. Moreover, these indicators have undergone various consultation processes based on scientific expertise, as well as including MS experts and stakeholders.

Based on the above, a broad number of potential indicators were first identified and a set of criteria were developed to select the most relevant indicators as potentially acting as good proxies for improvements in biodiversity state. In order to be operational in the short term, such indicators would have to satisfy a number of criteria, such as being based on data that are already available or will shortly be available in the EU. Therefore the criteria chosen for the purpose of the current evaluation of indicators were:

3. The indicator gives direct information about the state of biodiversity or the ecological quality of the ecosystem. Based on this, pressure indicators were excluded as often being indirect indicators of biodiversity.
4. The data are readily available or will shortly be available in the EU, and the data are reliable and updated periodically.

The indicators outlined below were evaluated against these criteria (see Table 1). Indicators need first to offer key information or proxy about the health and biodiversity quality of agroecosystems. Data availability and data robustness, in particular periodicity of updates and reliability, are also essential elements to consider. In particular indicators for which there are already obligations for reporting under other legislation (such as CAP or LULUCF), were considered as favourable elements in this respect.

The evaluation resulted in four indicators to be considered for the further analysis of impacts: **the grassland butterfly index, the share of agricultural land with landscape features, the organic carbon content in cropland mineral soils and the percentage of species and habitats of Community interest related to agriculture with stable or increasing trends**. Further information about these selected indicators is provided in the subsequent sections.

[140] Mapping and Assessment of Ecosystems and their Services - MAES - Environment - European Commission (europa.eu)
[141] Ecosystem Accounting | System of Environmental Economic Accounting

Table IV-7: Considered agroecosystem indicators

Indicator	Direct indicator of ecological/ biodiversity quality	Data availability	Periodicity of data updating	Reliability of data	Final assessment
Grassland butterfly index	Yes, grasslands butterflies are a very efficient proxy of grassland and ecosystem quality	Yes	Yes, available at EU level (16 MS covered)	Yes, CAP Impact indicator	Yes
Share of semi-natural eleme nts (landscap e features)	Provide benefits to biodiversity. Associated with management practices	Yes	Yes, every 3 years (LUCAS)	Yes, CAP Result and impact indicator	Yes
Organic carbon content in cropland mineral soils	Yes, strongly associated with key services like water holding capacity, resilience improvement, and is related to management practices	Yes	Yes, reported under LUCAS that provides data for Forest Europe. Every 5 years.	Yes, CAP Result and impact indicator	Yes
Enhanced biodiversity protection: species and habitats of community interest related to agriculture with stable or increasing trends	Yes, species and habitats of community interest are a very efficient proxy of ecosystem quality, mostly for protected area and extensive grassland	Yes	Yes, every 6 years	Yes, CAP impact indicator	Yes
Soil sealing (from land take)	No, Indirect measure of loss of habitat and even more indirect measure of ecological/biodiversity quality	Yes	Yes	Yes	No
Percentage of cropland and grassland covered by Natura 2000	No, Indirect measure of ecological/biodiversity quality	Yes	Yes	Yes, CAP Result indicator	No
Farmland bird index	Yes, but taken up in another target	Yes	Yes	Yes, CAP Impact indicator	No
Wild pollinators index	Yes, but no data available	No	No	No	No
Invasive alien species	No, Pressure indicator and not a direct measure of	Yes	Yes	Yes, but covered in a separate legislation.	No

	ecological/biodiversity quality				
Soil biodiversity	Yes, Direct measure of ecological/biodiversity quality	No, data available only later in 2022	Yes	Yes, but limited in sample	No
Crop genetic diversity	No, insufficient measure of ecological/biodiversity quality	No	NA	No	No
Connectivity of semi-natural elements	No, insufficient measure of ecological/biodiversity quality	No	NA	No	No
Share of fallow land	No, insufficient measure of ecological/biodiversity quality	Yes	Yes	Yes, CAP Result and impact indicator	No
Crop diversity (spatial and temporal)	No, insufficient measure of ecological/biodiversity quality	Yes, to be developed	Yes	Yes, CAP Impact Indicator	No
Exceedances of critical loads for acidification	No, indirect measure of ecological/biodiversity quality	Yes	Yes	Yes	No
Exceedances of critical loads for eutrophicatio n	No, indirect measure of ecological/biodiversity quality	Yes	Yes	Yes	No
Depth of the water table	No, indirect measure of ecological/biodiversity quality	No	NA	No	No
Soil compaction	No, indirect measure of ecological/biodiversity quality	No, only Partially	No	No	No
Organic soils no longer losing carbon	No, associated with land use change but indirect measure of ecological/biodiversity quality	No	No	No	No
Heavy metals in soil	No, indirect measure of ecological/biodiversity quality	Yes	No, only partially updated	No	No
Plastics in soil	No, indirect measure of ecological/biodiversity quality	No	No	No	No
Pesticides residues in soil	No, indirect measure of ecological/biodiversity quality	No – in preparation (2022)	No, partially	No	No

Veterinary antibiotics in soil	No, indirect measure of ecological/biodiversity quality	No	No	No	No
Acidification in soil	No, indirect measure of ecological/biodiversity quality	Yes	Yes	Yes	No
Soil salinisation	No, indirect measure of ecological/biodiversity quality	No	No	No	No
Gross nutrient balance	No, indirect measure of ecological/biodiversity quality	Yes	Yes	Yes, CAP Impact Indicator	No
Mineral fertilizer consumption (n)	No, Pressure indicator and not a direct measure of ecological/biodiversity quality	Yes	Yes	Yes, CAP Result indicator	No
Mineral fertilizer consumption (p)	No, Pressure indicator and not a direct measure of ecological/biodiversity quality	Yes	Yes	Yes, CAP Result indicator	No
Pesticide use and risk	No, Pressure indicator and not a direct measure of ecological/biodiversity quality	Yes	Yes	Yes, CAP Result and Impact Indicator	No
Water abstraction by agriculture	No, Pressure indicator and not a direct measure of ecological/biodiversity quality	No	No	Yes, CAP Result and Impact Indicator	No
Soil erosion	No, Indirect measure of ecological/biodiversity quality	Yes	Yes	Yes, CAP Result and Impact Indicator	No

Grassland Butterfly Index

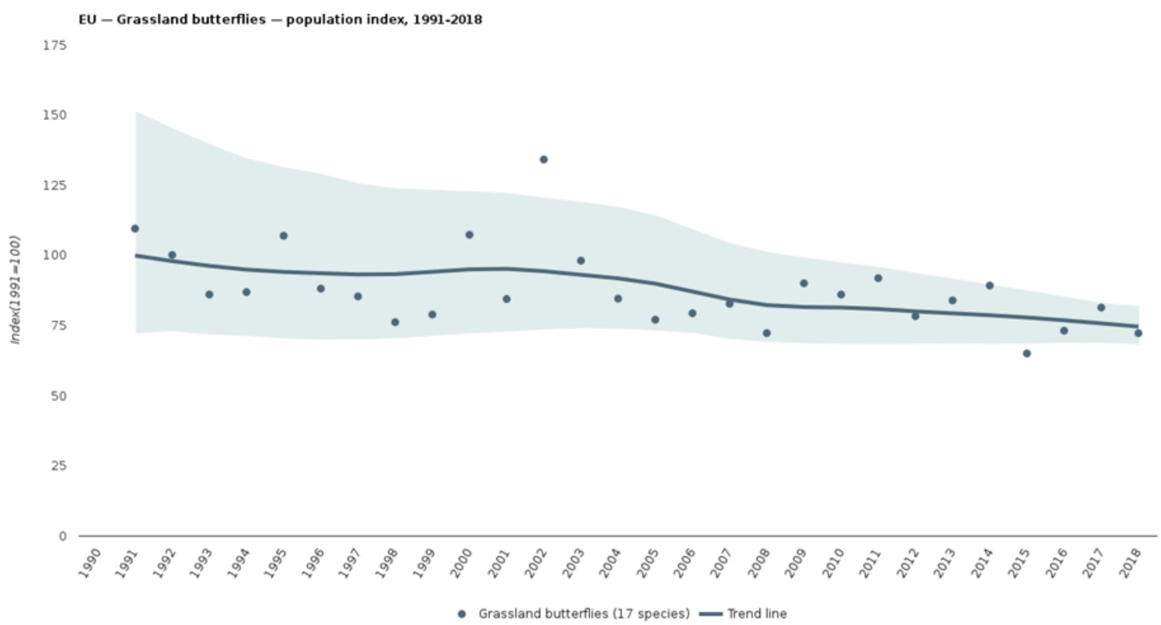
Background

As the majority of grasslands in Europe requires active management by humans or sustainable grazing by livestock, butterflies also depend on the continuation of these activities. The main driver behind the decline of grassland butterflies is thought to be changes in rural land use. In some regions, grassland habitats have deteriorated due to agricultural intensification, while in other regions (such as more remote mountain areas) the main problem is land abandonment or afforestation. In both cases, the situation for butterflies is the same as their habitats become less suitable for breeding. When land use is intensified, host plants often disappear or the management becomes unsuitable for larval survival. In the case of abandonment, the grassland quickly becomes tall and rank, and is soon replaced by scrub and eventually woodland.

Large parts of Europe are used for agricultural purposes, and grasslands are a major land-cover type within these areas. For centuries, grasslands have formed an important part of the European landscape. Sustainably managed semi-natural grassland harbours a high biodiversity, especially of plants, butterflies and many other insect groups. Grasslands are the main habitat for many European butterflies. Out of 436 butterfly species in Europe for which information on habitat type is available, 382 (88 %) are on grasslands in at least one country in Europe, and for more than half of the species (280 species, 57 %) grassland is their main habitat. Grassland butterflies have undergone a huge overall decrease in numbers.

Between 1991 and 2018, the EU Butterfly Indicator for Grassland species showed a significant decline of 25% in the 17 EU countries with monitoring data. While the decline has slowed in the past few years, the grassland butterfly index still fell by 5% between 2013 and 2018. Moreover, [142]. The 2010 Red List of European butterflies listed 38 of the 482 European species (8%) as threatened and 44 species (10%) as near threatened (note that 47 species were not assessed) (van Swaay et al., 2020).

Figure IV-1 Grassland butterflies – population index, 1991-2018. Source: EEA



Notes:
Source: EEA, Butterfly Conservation Europe, European Butterfly Monitoring Scheme partnership, Assessing Butterflies in Europe (ABLE) project.

The shaded area represents the confidence limits.

Geographical coverage: Austria, Belgium, Czechia, Estonia, Finland, France, Germany, Hungary, Ireland, Latvia, Lithuania, Luxembourg, Netherlands, Romania, Spain, Slovenia, Sweden.

Thomas (2005)[143] argued that butterflies are good indicators of insects, which comprise the most species-rich group of animals in Europe. The trend in grassland butterflies is thus an indicator for the health of grassland ecosystems and their component biodiversity. Insects play a crucial role in pollination services and the health of the ecosystems on which they depend is important for Europe's future economic and social well-being.

[142] Van Swaay, C. A. M., et al., 2020, Assessing butterflies in Europe — butterfly indicators 1990-2018: technical report, Butterfly Conservation Europe and ABLE/eBMS.

[143] Thomas, Jeremy A., et al. "Comparative losses of British butterflies, birds, and plants and the global extinction crisis." *Science* 303.5665 (2004): 1879-1881.

Grasslands and their butterflies are highly dependent on activities such as grazing or mowing. Traditional forms of farming management, such as extensive livestock grazing and hay-making where fertiliser and pesticide use are minimal, provide an ideal environment for these butterflies. In recent decades, large areas of grassland have become abandoned, furthermore many villages in the European countryside have become abandoned for social and economic reasons. Following abandonment, some butterfly species flourish for a few years because of the lack of management, but thereafter scrub and trees invade and the grassland disappears, including its rich flora and butterfly fauna. Eventually, the vegetation reverts to scrubland and forest, eliminating grassland butterflies. In western Europe, farming has intensified rapidly and over the last 50 years and semi-natural grasslands have become greatly reduced in area. Related threats to grassland butterflies in Europe include fragmentation, the use of pesticides and climate change.

Details of the indicator

Butterflies are ideal biological indicators: they are well-documented, measurable, sensitive to environmental and climate change (what rapidly results in demographical responses due to their short generation time), occur in a wide range of habitat types but with highly characteristic species assemblages[144], are popular with the public because of their beauty, and represent many other insects as well as species of higher taxonomical level. For instance, Fleishman et al. (2005)[145] found that models explaining butterflies distributions in North America also explained birds distributions. Field monitoring is essential to assess changes in their abundance. Indicators based on butterfly monitoring data are valuable to understand the state of the environment and help evaluate policy and implementation.

Because butterflies require different resources along their phenology (i.e., food and nesting resources, host plants for their larvae) and are mobile organisms (some species are migratory). Trends in the abundance and distribution of their populations can inform not only about local conditions but also about changes in ecosystems at regional and EU level over time.

Another advantage of European grassland butterflies as biological indicators in the current policy context, is that they are highly sensitive to habitat loss/degradation, chemical pollution, and climate change[146], some of the main pressures on biodiversity that different European policies are trying to revert. In the case of European grasslands[147]. Thus, the relationship between the intensity of agricultural management and this taxon makes an indicator based on the population trends of these insects a good proxy for the structural and functional condition of these habitats.

[144] Stefanescu, Constantí, Josep Peñuelas, and Iolanda Filella. "Butterflies highlight the conservation value of hay meadows highly threatened by land-use changes in a protected Mediterranean area." *Biological Conservation* 126.2 (2005): 234-246.
[145] Fleishman, Erica, et al. "Using indicator species to predict species richness of multiple taxonomic groups." *Conservation biology* 19.4 (2005): 1125-1137.
[146] Warren, Martin S., et al. "The decline of butterflies in Europe: Problems, significance, and possible solutions." *Proceedings of the National Academy of Sciences* 118.2 (2021).
[147] Bubová, T., Vrabec, V., Kulma, M., & Nowicki, P. (2015). Land management impacts on European butterflies of conservation concern: a review. *Journal of Insect Conservation*, *19*(5), 805-821.

The EU Grassland Butterfly Indicator is one of the indicators of the status of biodiversity in the European Union[148]. It is an indicator showing trends in abundance of populations of seventeen typical grassland butterfly species in different EU countries.

Based on the establishment of butterfly monitoring schemes in a number of European countries that collect annual data to a scientific standard over a wide geographical area, population trends of butterflies now represent an important source indicator[149]. In its last update up to 2018, more than 4000 transects covering 17 countries were used to assess the trends of these insects populations. The indicator is based on the fieldwork of trained professional and volunteer recorders, counting butterflies under standardised conditions with national coordinators collecting the data and performing quality control[150]. National population trends from the Butterfly Monitoring Schemes, are combined to form supra-national species trends. These trends per butterfly species are then combined into the indicator following the method described by Gregory et al. (2005)[151] for an equivalent bird index.

The Grassland Butterfly Indicator demonstrates how butterflies respond quickly to changes in the environment and how butterflies are thus a good 'early warning' indicator of changes in Europe's biodiversity. The distribution of butterflies has been found to be a good predictor of areas of high biodiversity, species richness or habitat quality in many studies. In addition, butterflies are relatively easy to recognize and data on butterflies has been collected for many years and the method for monitoring butterflies is well described, extensively tested and scientifically sound[152].

Environmental impacts

Wild pollinator communities are indicators of ecosystem health and react quickly to environmental change. The main driver of their decline is the intensification of farming and changes in rural land use, resulting in habitat loss and degradation[153,154,155]. The loss of species-rich semi-natural grasslands has been particularly detrimental[156]. Moreover, agricultural intensification can entail high inputs of agrochemicals, including pesticides, which can dramatically reduce insect populations, including butterflies. Urban sprawl increases light pollution (i.e. artificial light at night), which is another major driver of insect decline[157]. Other drivers of population loss are invasive alien species and climate change[158].

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148 Van Swaay, C.A.M., et al. The EU Butterfly Indicator for Grassland species: 1990-2017. Technical report. 2019

149 Brereton, T., van Swaay, C. H. R. I. S., & van Strien, A. R. C. O. (2009). Developing a butterfly indicator to assess changes in Europe's biodiversity. In *Conference proceedings of the European bird census council bird* (pp. 78-97).

150 Van Swaay, C.A.M., et al. The EU Butterfly Indicator for Grassland species: 1990-2017. Technical report. 2019

151 Gregory, Richard D., et al. "Developing indicators for European birds." *Philosophical Transactions of the Royal Society B: Biological Sciences* 360.1454 (2005): 269-288.

152 Brereton, T., van Swaay, C. H. R. I. S., & van Strien, A. R. C. O. (2009). Developing a butterfly indicator to assess changes in Europe's biodiversity. In *Conference proceedings of the European bird census council bird* (pp. 78-97).

153 Sánchez-Bayoa, F. and Wyckhuys, K.A.G. Worldwide decline of the entomofauna: A review of its drivers. Biological Conservation (2019). DOI: 10.1016/j.biocon.2019.01.020

154 Hallmann, C.A. et al. More than 75 percent decline over 27 years in total flying insect biomass in protected areas. PLoS One (2017). DOI: 10.1371/journal.pone.0185809

155 Van Swaay, et al. Assessing Butterflies in Europe - Butterfly Indicators 1990-2018 Technical report. Butterfly Conservation Europe & ABLE/eBMS (www.butterfly-monitoring.net)

156 Nilsson, S. G., Franzén, M. and Pettersson, L., 2013, 'Land-use changes, farm management and the decline of butterflies associated with semi-natural grasslands in southern Sweden', *Nature Conservation* 6, pp. 31–48

157 Owens, A. C. S., Cochard, P. and Durrant, J., 2020, 'Light pollution is a driver of insect declines', *Biological Conservation* 241

158 ibid 12.

Insects are a vital component of biodiversity because they comprise over half of the world's terrestrial species and butterflies are an important part of such a contribution to global diversity and to ecosystems functioning providing pollination services. More than 90% of wild flowers rely upon these services for their reproduction[159,160] as well as 75% of crop species[161]. Therefore, as pollinators, butterflies also contribute to wild plant conservation and crop production also ensuring the survival of other animals such as birds in higher levels of the food web. This pollination service can be of particular importance for some plant species with long corolla tubes where only butterflies tongue lengths can reach the flower sexual organs and transfer pollen among individuals.

84 % of the crops grown in Europe benefit at least partly from animal pollination[162], including fruits, vegetables, nuts, oil crops, pulses and legumes, crops grown for fibre or fuel or for animal food. Over 78 % of wild plants in the EU rely on pollinating insects[163], including many medicinal plants.

Grassland butterflies are an indicator of grassland condition. Natural and semi-natural grasslands are core components of High Nature. Extensive literature exists on the role of natural and semi-natural grasslands as ecosystem services providers[164] and in particular of regulating and cultural ecosystem services. Moreover, Bengtsson et al. (2019)[165] underline the fact that semi-natural grasslands in Europe should increase in area to meet the demand for the many services they could provide.

Socio-Economic Impacts

It is estimated that more than 150 (84%) of European crops are directly dependent upon insects for their pollination. Crop pollination by honeybees alone is estimated to be worth €4.25 billion per year in Europe. Dependence upon a single pollinator for crop production can be a risky strategy and many other pollinator species are known to provide excellent pollination services. Bumblebees, for instance, are important pollinators of several European crops and together with other non-honeybee pollinators are estimated to provide services worth more than €750 million per year[166].

Productivity, livestock carrying capacity and biodiversity are all strongly interrelated and high biodiversity and high economic yield are considered incompatible at higher levels of productivity. High levels of biodiversity seem to be confined to less productive conditions, with an inherently low carrying capacity for livestock and low marginal returns. These mathematical relationships

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[159] Costanza, Robert, et al. "The value of the world's ecosystem services and natural capital." *nature* 387.6630 (1997): 253-260.
[160] Ollerton, Jeff, Rachael Winfree, and Sam Tarrant. "How many flowering plants are pollinated by animals?." *Oikos* 120.3 (2011): 321-326.
[161] Bos, Merijn M., et al. "Caveats to quantifying ecosystem services: fruit abortion blurs benefits from crop pollination." *Ecological Applications* 17.6 (2007): 1841-1849.
[162] Williams, Ingrid H. "The dependence of crop production within the European Union on pollination by honey bees." *Agric. Zool. Rev.* 6 (1994): 229-257.
[163] Ibid 141
[164] Veen, P., et al, Grasslands in Europe of high nature value. KNNV Uitgeverli, 320 p. (2009)
[165] Bengtsson, J., et al, Grasslands—more important for ecosystem services than you might think, Ecosphere, 10 (2019).
[166] Borneck, R. and Merle, B. (1989) Essaie d'une evaluation de l'incidence économique de l'abeille pollinisatrice dans l'agriculture européenne. Apicata 24: 33-38.

are, however, an oversimplification[167]. In fact, plant species diversity contribute to more resilient agricultural systems, and farmers can benefit economically from this diversity as it contributes to more stable grassland-based production by increasing and stabilizing biomass yields[168].

In a 2017 study[169], authors explore the economic value of increasing biomass accumulation as local species richness increases in grassland habitats, demonstrating positive marginal value of species richness for carbon storage. The study is based on plant diversity, which is key to shape other biological communities composition. Relevance should be given to the fact that other ecosystem services are also sensitive to biodiversity loss.

As part of the reformed Common Agricultural Policy to be implemented under the period 2023-2027, the eco-schemes are a set of instruments designed to reward farmers for improved environmental and climate agricultural practices at their exploitations. These eco-schemes consist on financial support granted to farmers to compensate for additional costs and foregone income derived from the implementation of such practices. Eco-schemes can also represent economic incentives to perform the necessary improvements to manage the transition towards more sustainable food systems. They can therefore be used to get an indirect measure of the economic value of these environmental actions. Figures may vary among member states depending on their agricultural contexts so we provide some examples of proposed payments under eco-schemes targeting farmland management for improved environmental performance including grasslands. The examples are taken from draft strategic plans published by member states before their final approval.

Ireland, to promote traditional grassland farming practices at extensive animal stocking rates, proposes a yearly payment rate per hectare that ranges from a minimum of 66€ to a maximum of 131€. Payments vary depending on the eligible farmers partaking the eco-schemes that operates at national level.

Spain, proposes eco-schemes including different agricultural practices to increase carbon sink capacity and to improve biodiversity in grasslands. Yearly payments differ depending on the type of grassland ranging from 51.42€/ha to 62.16€/ha in humid pastures, and from 33.99€/ha to 41.09€/ha in dry pastures.

These figures provide case study illustrations of the socio-economic benefits of increased numbers of butterfly populations, either directly since butterflies act as pollinators or indirectly since higher butterfly populations indicate the presence of healthy grasslands and that provide even broader socio-economic benefits.

High diversity landscape features

Background information

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[167] Hodgson, J. G., Montserrat-Martı, G., Tallowin, J., Thompson, K., Díaz, S., Cabido, M., ... & Zak, M. R. (2005). How much will it cost to save grassland diversity?. *Biological conservation*, *122*(2), 263-273.
[168] Schaub, S., Buchmann, N., Lüscher, A., & Finger, R. (2020). Economic benefits from plant species diversity in intensively managed grasslands. Ecological Economics, 168, 106488.
[169] Hungate, B. A., Barbier, E. B., Ando, A. W., Marks, S. P., Reich, P. B., Van Gestel, N., ... & Cardinale, B. J. (2017). The economic value of grassland species for carbon storage. Science Advances, 3(4), e1601880

The Biodiversity Strategy to 2030 pointed to the need to increase landscape features in agricultural areas, and underlined that there is an urgent need to bring back at least 10% of agricultural area under high-diversity landscape features. These areas include, buffer strips, rotational or non-rotational fallow land, hedges, non-productive trees, terrace walls, and ponds. They are important for biodiversity as they provide space for wild animals, plants, pollinators and natural pest regulators. They also help enhance carbon sequestration, prevent soil erosion and depletion, filter air and water, and support climate adaptation.

For the purposes of the Green Deal, High-diversity landscape features (HDLF) include A*gricultural Landscape Features* (ALF) and Land Lying Fallow (LLF). ALFs are (small) fragments of non-productive natural or semi-natural permanent vegetation. Further important subtypes of HDLF include L*and Lying Fallow* (LLF) established for biodiversity goals (with no productive functions), as well as the woody components of (arable) agroforestry systems. An indicator for ALF will be included among the context and impact indicators of the PMEF (Performance Monitoring and Evaluation Framework) of the new CAP (Common Agricultural Policy), and information on LLF can be extracted from the relevant CAP data sets.

Recommendations to MSs for the preparation of the CAP Strategic Plan (2020, Annex I) identified reference values for the quantified Green Deal targets in the area of agriculture. As regards the 10% of agricultural area under high-diversity landscape features, the document used as indicator the share of agricultural area under high diversity landscape features (4.6% for EU-27). This value originated from Directorate General for Agriculture and Rural Development (based on EUROSTAT for land laying fallow and the Joint Research Centre based on LUCAS survey for estimation of landscape elements; the Recommendations added that these be taken with caution because of methodological caveats. It added that the Commission and the European Environmental Agency are developing a more robust indicator in the framework of the CAP post-2020 to ensure all elements defined in the EU 2030 Biodiversity Strategy are covered).

Details of the indicator

High-diversity landscape features are elements of permanent natural or semi-natural vegetation present in an agricultural context which provide ecosystem services and support for biodiversity. In order to do so, landscape features need to be subject to as little external disturbances as possible to provide safe habitats for various taxa, and therefore need to comply with the following conditions:

a) they cannot be under productive agricultural use (including grazing or fodder production), and
b) they should not receive fertilizer or pesticide treatment

Land lying fallow, productive trees part of arable land agroforestry systems and productive elements in non-productive hedges, can also be considered as high diversity landscape features, if they comply with criteria (a) and (b) above, and, in the case of the two types of productive elements mentioned in this paragraph, if harvests take place only at moments where it would not compromise high biodiversity levels.

This definition can be represented with two key component indicators of HDLF. These have different ecological characteristics, and they are also quite different from the perspective of management and policy (e.g. LLF responds much faster to policy changes). The two indicators are:

- A*gricultural Landscape Features* (ALF) : The new CAP includes indicators I.21 "*Share of agricultural land covered with landscape features*" (which is labelled also as a context indicator). This indicator will focus on agricultural LF (small non-productive LF embedded in agricultural land[170]), distinguishing four functionally different subtypes of ALF (woody, grassy, wet, and stony ALF). This indicator will rely on two key sources of raw information at the EU level, including the Copernicus Small Woody Feature (SWF) layer and the LUCAS LF surveys (Land Use/Cover Area frame Survey, Landscape Features module). Copernicus SWF (available from 2015 (& 2018 coming soon)) is a wall-to-wall mapping product covering the EEA countries. It captures woody linear structures , such as hedgerows, scrubs or tree rows along field boundaries, riparian and roadside vegetation, patches of trees and scrub. The LUCAS LF module is a newly planned survey to provide a new data source on landscape features. It will be first launched in the next LUCAS survey (2022), which will provide a consistent overview of the main LF types relevant in Europe in a statistically representative sample. The relevant CAP indicators are listed under Annex I of Reg. (EU) 2021/2115[171].
- L*and Lying Fallow* (LLF): In contrast with ALF, which are typically situated in the (small) spaces adjacent to, between or within the agricultural parcels, LLF is a land use subtype of (the parcels themselves. LLF is actually a land use category similar to crop types, which is recorded in the GSAA (GeoSpatial Aid Application) systems of the MS implementing the CAP. Accordingly, it is possible to create an indicator for the *share of agricultural land lying fallow* based on the GSAA records.

Environmental impacts

The most important direct driver of biodiversity loss in the past 50 years has been land cover change, involving the loss and fragmentation of species habitats[172]. Therefore, introducing or preserving non-productive landscape features provides substantial benefits for biodiversity in agricultural landscapes. As a result, landscapes and habitats become more heterogeneous both in space and time, providing local environmental conditions and resources for a broader variety of species and along their entire phenological cycles (e.g. resources for overwintering, nesting, feeding, etc, in the case of animals). Habitat connectivity increases, enabling crossings between individuals of different populations as well as enabling, plant and animal populations to disperse and migrate across landscapes, which is of particular importance in the context of climate

[170] Czúcz B, Baruth B, Terres JM, Hagyó A, Gallego J, Angileri V, Nocita M, Perez Soba M, Koeble R, Paracchini ML: *Classification and quantification of Landscape Features across the EU: A brief review of existing definitions, typologies, and data sources for quantification*. Publications Office of the European Union, Luxembourg, 2022

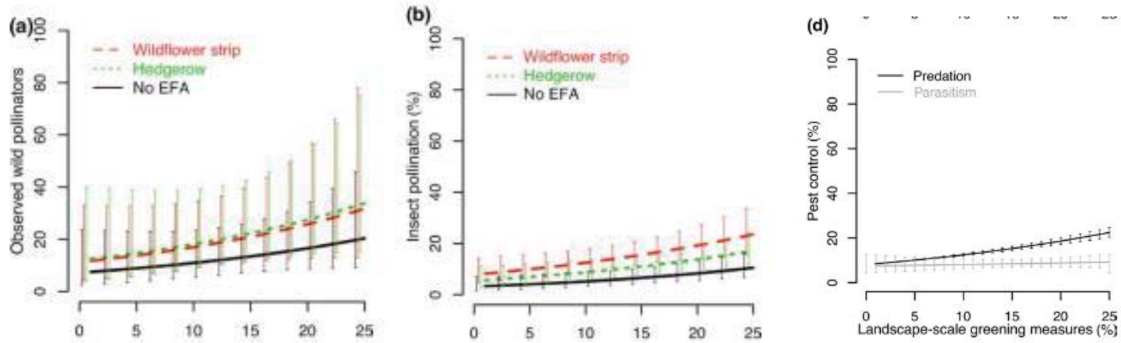
[171] Regulation (EU) 2021/2115 of the European Parliament and of the Council of 2 December 2021, OJ L 435, p.1, of 6.12.21; https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L:2021:435:TOC

[172] Millennium Ecosystem Assessment (2005) Ecosystems and human well-being: biodiversity synthesis. World Resources Institute, Washington, DC.

adaptation and genetic diversity. Increased populations of beneficial insects, spiders, and birds bring agronomic benefits through pollination or by controlling crop pests.

EU funded research found strong positive evidence that seminatural habitats in the agrarian matrix support pollinators and pest predators, based on a thorough review of available literature on the topic[173]. Field studies showed that insect pollination potential and pest predation increased on average by 10% and 13%, respectively, when landscape features share in agricultural land was increased from 6% to 26% (Figure IV-2)[174,175 176], increase carbon sequestration[177,178], soil

Figure IV-2 Effects of greening measures and adjacent Ecological Focus Areas (EFA) Source: Sutter et al, (2018).



(wildflower strip [red], hedgerow [green], and no EFA [black]) on (a) number of observed wild pollinator visits per plot (2 m2 , 10 min), (b) "local pollination potential" increase in seed set driven by insect pollination (%), (d) predation on pollen beetle (black) and pollen beetle parasitism (grey).

nutrients[179]and soil water retention[180] in their surroundings, as well as the water quality in nearby water streams[181], while they decrease nutrient leaching and soil erosion[182,]. Such environmental outputs depend on the type of landscape feature. Moreover, a meta-analysis of 127 monitoring studies[183] revealed that the numbers of species of birds, insects, spiders and plants were significantly higher on set-aside land than on nearby control areas under conventional agriculture. The population densities of all four taxa were also higher on set-aside land. In this study set-aside is defined as "all or part of a field subjected to, for at least one growing season, low or no fertilizer or chemical inputs, low or no grazing or tillage, and mowing no earlier than late June, if at all, with

[173] Holland, J.M., Douma, J.C., Crowley, L., James, L., Kor, L., Stevenson, D., Smith, B.M. (2017) Semi-natural habitats support biological control, pollination and soil conservation in Europe: A review. Agronomy for Sustainable Development, 37:31.
[174] Sutter, L., Albrecht, M., & Jeanneret, P. (2018). Landscape greening and local creation of wildflower strips and hedgerows promote multiple ecosystem services. Journal of applied ecology, 55(2), 612-620
[175] Holland et al., 2017.
[176] Van Vooren, L., Reubens, B., Broekx, S., Reheul, D., & Verheyen, K. (2018). Assessing the impact of grassland management extensification in temperate areas on multiple ecosystem services and biodiversity. Agriculture, Ecosystems & Environment, 267, 201-212.
[177] Drexler, S., Gensior, A. _& Don, A. (2021) Carbon sequestration in hedgerow biomass and soil in the temperate climate zone. Regional Environmental Change, 21(3), 74.
[178] Zheng, Y.L., Wang, H.Y., Qin, Q.Q. & Wang, Y.G. (2020) Effect of plant hedgerows on agricultural non-point source pollution: a meta-analysis. Environmental Sciences and Pollution Research, 27(20), 24831-24847.
[179] Wei, W., Chen, D., Wang, L.X., Daryanto, S., Chen, L.D., Yu, Y., Lu, Y.L., Sun, G. & Feng, T.J. (2016) Global synthesis of the classifications, distributions, benefits and issues of terracing. Earth-Science Reviews, 159, 388-403.
[180] Zhang, X.Y., Liu, X.M., Zhang, M.H., Dahlgren, R.A., Eitzel, M. (2010) Review of vegetated buffers and a meta-analysis of their mitigation efficacy in reducing nonpoint source pollution. Journal of environmental quality, 39, 76-84.
[181] Van Vooren, L., Reubens, B., Broekx, S., De Frenne, P., Nelissen, V., Pardon, P. & Verheyen, K. (2017) Ecosystem service delivery of agri-environment measures: a synthesis for hedgerows and grass strips on arable land. Agriculture, Ecosystems and Environment, 244 32-51.
[182] Valkama, E., Usva, K., Saarinen, M. & Uusi-Kamppa, J. (2019) A meta-analysis on nitrogen retention by buffer zones. Journal of Environmental Quality, 48(2), 270-279.
[183] Van Buskirk , J. and Willi , Y, Enhancement of farmland biodiversity within set-aside land. Conservation Biology 18 (4) : 987-994, (2004)

vegetation either naturally regenerated or sown at the beginning with grass or wildflower mixtures”.

Socio-Economic Impacts

In agricultural areas, an estimation of the costs for establishing and maintaining landscape features can be provided by looking at the premiums paid to farmer in the frame of CAP Pillar II. This then provides an estimation of the “willingness to pay” by the public sector to maintain such areas. In particular, Measure 10 of Rural Development Programs 2014-2022 supports the maintenance of landscape features on agricultural land, while Measure 4 supports non productive investments including the establishment of new landscape features. Similar measures are contained in the forthcoming CAP Strategic plans in the form of eco-schemes and Agri-Environmental climate measures, provided they go beyond the baseline (GAEC 8, cfr Annex III of Regulation (EU) 2021/2115).

As a general rule, the amount of the financial support granted to farmers is determined to compensate for additional costs and foregone income: eco-schemes can also provide incentives. They therefore represent a good proxy of the cost that society as a whole is willing to pay for the establishment of these features and the enhancement of the benefits derived from a functioning landscape features network. Figures vary from country to country, in the following the most recent available information from some CAP Strategic Plans is reported:

Table IV-8 Ireland (AECM General)

Type of Landscape Feature	Unit	Amount
Grass margin on arable land (3 m width)	Linear meter (lm)	0.38 €/lm (=0.127 €/m^2)
Grass margin on grassland		
Plantation of new hedgerows	Linear metre	5.29 €/lm (≈ 1.76 – 2.65 €/m^2)
Planting Trees- Rows Groups or Parkland	Unit (tree)	6.21 €/tree
Riparian Buffer Zone adjacent to arable land	Hectare (ha)	1,242 €/ha (= 0.124 €/m^2)

In France, the basic Eco-Scheme supports the creation of Landscape features to cover up to 7% of UAA (level 1) at the rate of 60 €/ha UAA or up to 10% (level 2) at the rate of 82 €/ha UAA. Considering that the compulsory baseline value as for GAEC 8 is 4% of UAA covered by landscape features, this means that the cost paid is 1,367-2,000 €/ha or 0.137-0.2 €/m^2 of surface of landscape feature[184], very close to the Irish figures.

The Italian CAP SP has two specific Agri-Environmental climate measures for i) the creation and ii) maintenance of landscape features, including hedges, buffer strips, tree lines, woodlots, wet areas, riparian zones. Specific details on implementation will be subsequently defined at regional level but the maximum amount per ha of UAA for the two measures is 83.48 €/ha and 119.84 €/ha respectively, so final figures should be comparable to the French ones.

[184] These figures refer to landscape features in general, for hedgerows in particular there is an additional bonus of 7 Euros/m^2 (top up).

An EU analysis based on the CAPRI-model[185] suggests that an increase to 10% landscape features could reduce agricultural output by 2.1% and increase produces prices of crops and cattle by 2.2%. However, the study report acknowledges that it tends to overestimate the impact because it does not consider other influencing factors such as possible positive feedback loops (e.g. landscape features attracting pollinators which can increase agricultural yield) and policy measures supporting the transition. The same study also reports positive environmental impacts of increasing landscape features, e.g. reduction of harmful emissions.

In summary, increases of the in the landscape features indicator would directly provide direct evidence of improvements in biodiversity and environment. Based on the case examples provided a number of socio-economic benefits can be expected, including of how much society is willing to pay to ensure landscape features.

Soil organic carbon in cropland mineral soils

Background information

Soil organic carbon is the major component of soil organic matter. Organic matter in soil is essentially derived from residual plant and animal material, synthesised by microbes and decomposed under the influence of temperature, moisture and ambient soil conditions. The vast percentage of cropland soils in the EU are mineral soils. Mineral soils are defined by having an organic carbon content below 20%, although more generally it is below 5%.

Soil organic carbon (SOC) is a key indicator for soil health as it point to levels of biological, chemical and physical processes. These in turn underpin the delivery of all soil ecosystem services including carbon sequestration, soil fertility, water regulation, nutrient cycling and hazard risk mitigation. In terms of carbon sequestration, carbon stocks in EU-27 agricultural soils are estimated to be around 13,350 Mt C (or 48,950 Mt CO_2eq) in the topsoil (generally 0-30 cm).

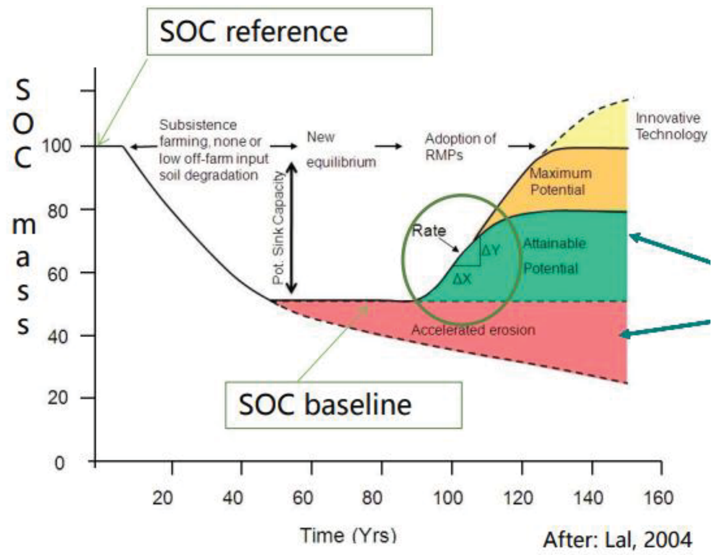
A range of pressures threaten both organic and mineral soils driving their SOC content below critically low levels, including land management choices/changes, reclamation and drainage of organic soils, soil erosion, peat extraction, soil sealing, and climate change. Every year mineral soils under cropland are losing around 7.4 million tonnes of carbon, caused mainly by unsustainable farming practices. Soil restoration is urgently needed as soils provide the main foundation for life on Earth, both above and below ground, yet soil condition is deteriorating in the EU where around 60-70% of soils are estimated to be unhealthy[186].

[185] Supplementary material (provided by the author) to the study: Barreiro-Hurle, J., Bogonos, M., Himics, M., Hristov, J., Pérez-Domiguez, I., Sahoo, A., Salputra, G., Weiss, F., Baldoni, E., Elleby, C. Modelling environmental and climate ambition in the agricultural sector with the CAPRI model. Exploring the potential effects of selected Farm to Fork and Biodiversity strategies targets in the framework of the 2030 Climate targets and the post 2020 Common Agricultural Policy, EUR 30317 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-20889-1, doi:10.2760/98160, JRC121368.

[186] https://ec.europa.eu/info/publications/caring-soil-caring-life_en

Around 45 % of EU mineral soils have low or very low SOC and 1.5 % have extremely low SOC levels with lowest levels in Southern Europe[187,188] and arable soils[189,190,191,192]. Data from LUCAS Soil surveys shows that in particular cropland soils contain the lowest levels of organic matter concentrations of any major land cover category[193]. Overall, EU SOC stocks in mineral soils have not changed significantly in the past decade. This is due to the plateauing of stocks towards a low steady state that is below optimal levels and reflects the significant loss of carbon stock in intensively managed arable soils. The current state mirrors a carbon input-output equilibrium where the rate of carbon inputs are matched by removals (e.g. harvest, mineralisation and erosion), echoing the consequences of continued long-term farming systems on soil condition.

Figure IV-3. Source: Lal, (2004)[194]



Despite this aggregate trend, key regional hotspots are experiencing notable SOC decreases in the Mediterranean and central-eastern Europe. Most areas at risk of critically low and decreasing SOC are on arable land, with decreases of 2.5 % in SOC concentrations reported in cropland from 2009-2015. Grasslands likely have an overall stable or slightly increasing SOC stocks. Trends in forest

[187] Tanneberger, et al (2017) The peatland map of Europe. Mires and Peat No 19 (22), 1-17. (Online: http://www.mires-and-peat.net/pages/volumes/map19/map1922.php. Schils, R, Kuikman, P, Liski, J, Van Oijen, M, Smith, P, Webb, J, Alm, J, Somogyi, Z, Van der Akker, J, Billett, M, Emmett, B, Evans, C, Lindner, M, Palosuo, T, Bellamy, P, Jandl, R and Hiederer, R (2008) Review of Existing Information on the Interrelations between Soil and Climate Change (CLIMSOIL final report). Contract number 070307/2007/486157/SER/B1, European Commission, Brussels.

[188] Schils, et al (2008). Review of Existing Information on the Interrelations between Soil and Climate Change (CLIMSOIL final report). Contract number 070307/2007/486157/SER/B1, European Commission, Brussels.

[189] Stolte, J, et al (2015). Soil threats in Europe: status, methods, drivers and effects on ecosystem services. JRC Technical Reports, 978-92-79-54019, Joint Research Centre, European Commission.

[190] Costantini, E., et al 2020. Local adaptation strategies to increase or maintain soil organic carbon content under arable farming in Europe: Inspirational ideas for setting operational groups within the European innovation partnership. Journal of Rural Studies, 79, pp.102-115.

[191] Maes et al (2020) Mapping and Assessment of Ecosystems and their Services: An EU wide ecosystem assessment in support of the EU biodiversity strategy. EUR 30161 EN, European Commission, Brussels.

[192] Jones, A, et al (2012) The State of Soil in Europe.

[193] Jones, A., Fernandez Ugalde, O. and Scarpa, S., LUCAS 2015 Topsoil Survey, EUR 30332 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-21080-1, doi:10.2760/616084, JRC121325.

[194] Lal, Rattan. "Soil carbon sequestration impacts on global climate change and food security." *science* 304.5677 (2004): 1623-1627.

soil stocks are uncertain but generally acting as a sink. The largest SOC declines from 2009-2015, of 11 % on average[195] were reported for areas converted from grassland to cropland.

In the absence of additional legally binding soil restoration targets, the current mineral and organic soil degradation trends in the EU are assumed to continue to 2030: mineral soils will continue experiencing low SOC levels on 45% of EU area. Stable trends in aggregate SOC levels are expected to 2030 with some differences across regions and land-uses. Arable land will continue experiencing critically low SOC on 2.6% of it area with regional hotspots. Despite a likely overall equilibrium between SOC gains and losses, many agricultural soils maybe unable to provide fully their expected ecosystem services and declines will continue in high-risk arable areas. Permanent grasslands will likely continue experiencing modest increases in SOC. The largest potential for SOC stock improvement is on degraded agricultural land as these areas are not saturated for SOC

Local carbon sequestration potentials vary across the EU as they depend on soil and climate variables. Practices which increase SOC stocks should be implemented following regional guidance adapted to local contexts[196]. The permanent conversion of arable land to grassland is particularly relevant as well as the maintenance of grassland and banning of ploughing on permanent grassland. Measures on arable land include improved crop rotations, residue management, cover cropping, agroforestry, and organic farming.

Details of the indicator

This indicator describes the amount (stock) of SOC: Soil organic carbon stocks in the topsoils of croplands (0-30 cm depth), expressed in tonnes or Mg per hectare. Soil organic carbon in mineral soil is the major component of soil organic matter, and is measured as the amount of organic carbon contained in soils.

Organic carbon content is derived through the laboratory analysis of a representative soil sample collected from the target depth and expressed as the gravimetric percentage of dry (105 °C)soil [g SOC kg-1]. Standard procedures for the determination of soil moisture are available. These include the dry combustion method, wet oxidation by dichromate ions, loss-on-ignition, spectroscopic techniques. Samples collected through the LUCAS survey are analysed following the ISO 10694:1995 Standard using the dry combustion method.

Data are available across Member States from LUCAS Soil[197] and JRC Biogeochemical modelling[198]. LUCAS data are field observations of cropland topsoils, which are collected every 3-4 years for all Member States. Data exist for 2009, 2015 and 2018. The next LUCAS sampling will take place in 2022 has been designed to provide statistically robust assessments of soil carbon

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[195] EUROSTAT, Eurostat regional yearbook — 2020 edition https://ec.europa.eu/eurostat/web/products-statistical-books/-/ks-ha-20-001

[196] Lugato, Emanuele, et al. "Potential carbon sequestration of European arable soils estimated by modelling a comprehensive set of management practices." *Global change biology* 20.11 (2014): 3557-3567.

[197] Jones, A., Fernandez Ugalde, O. and Scarpa, S., LUCAS 2015 Topsoil Survey, EUR 30332 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-21080-1, doi:10.2760/616084, JRC121325 and Panagos, P., Ballabio, C., Scarpa, S., Borrelli, P., Lugato, E. and Montanarella, L., Soil related indicators to support agro-environmental policies, EUR 30090 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-15645-1, doi:10.2760/889067, JRC119220.

[198] Lugato et al. 2014. A new baseline of organic carbon stock in European agricultural soils using a modelling approachhttps://onlinelibrary.wiley.com/doi/abs/10.1111/gcb.12292

stocks for croplands at NUTS 2 Level. Some Member States, such as France, have developed their own systems and data would then be reported by these national systems. As an action of the Soil Strategy, the JRC is collaborating with the EJP-Soil Project and others to develop a roadmap towards an integrated soil monitoring system for the EU, building on LUCAS and national or regional operational systems. It is hoped to be implemented for 2026. Through its WorldSoils Project, the European Space Agency is also investigating methods for monitoring SOC based on remote sensing data, large soil data archives and modelling techniques[199]

Robust evidence exists to show that land management and agricultural practices have an impact (both positive and negative on SOC stocks[200]). However, it should be noted that changes in SOC stocks are generally slow with significant change expected over a decade. Modelling approaches can be used to extrapolate changes at shorter time interval, however the general recommendation for soil (IPPC[201],FAO[202], Smith et al 2020[203]) is that in situ measures are needed to establish a baseline and provide independent estimates of large-scale SOC change on at least a decadal basis (or longer).

It is worth reflecting that SOC is a CAP Impact Indicator, used by the UNCCD methodology to define degraded land (SDG 15.3) and considered under the LULUCF Regulation. The approach used under LULUCF depends on changes in land use and land cover, and primarily uses modelling approaches.

In summary, this means that currently methods for measuring SOC are available across the EU MS, and that with time, these methods are likely to become more integrated and more accurate.

Environmental impacts

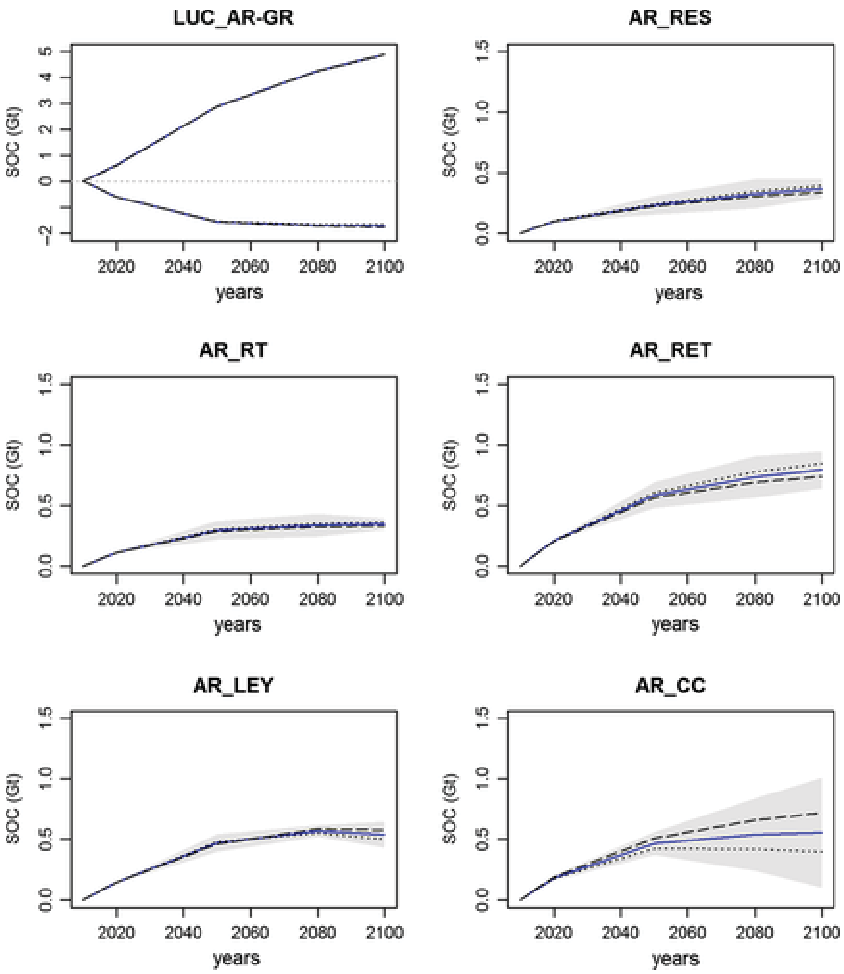
While there is a high level of interest in the potential of carbon sequestration in agricultural soils, farming practices that support soil carbon preservation and increased rates of sequestration generally enhance environmental quality through the provision of additional or enhanced benefits. These include an increase in infiltration, increased fertility and nutrient cycling, decreased wind and water erosion, reduced risk of compaction, enhanced water quality, decrease C emissions, impede pesticide movement and generally enhance environmental quality.

Mineral soils are defined by having an organic carbon content below 20%, although more generally it is below 5%. Every year mineral soils under cropland lose around 7.4 million tonnes of carbon, caused mainly by unsustainable farming practices. Carbon sequestration in mineral soils, while depending on soil type and climatic conditions, through targeted and continued sustainable management practices can significantly help in achieving climate neutrality by increasing the carbon stocked in mineral soils. Research shows that this is an effective emission mitigation

[199] WORLDSOILS Project Webiste (world-soils.com)
[200] https://onlinelibrary.wiley.com/doi/abs/10.1111/gcb.12551
[201] The Intergovernmental Panel on Climate Change (IPCC), IPCC Good Practice Guidance for LULUCF, Cropland, 2003. https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/Chp3/Chp3_3_Cropland.pdf
[202] FAO, Measuring and modelling soil carbon stocks and stock changes in livestock production systems : Guidelines for assessment, 2019. https://www.fao.org/3/ca2934en/CA2934EN.pdf
[203] Smith, P., et al, How to measure, report and verify soil carbon change to realize the potential of soil carbon sequestration for atmospheric greenhouse gas removal, Global change biology, 2019. https://doi.org/10.1111/gcb.14815

method with significant potential to sequester between 11 to 38 MtCO2eq annually in Europe if a range of management practices, which have already been identified are applied on a larger scale in arable land[204] (see Fig. IV-3 below). Many of these practices are cost-effective. In this regards, achieving net-zero greenhouse gas emissions by 2050 relies also on carbon removals through the restoration and better management of soils to store the atmospheric CO2.

Figure IV-4 Trend of cumulated SOC change (Gt of C) at pan-EU level in relation to the different simulated agricultural management practices. Source: Lugato et al, 2014



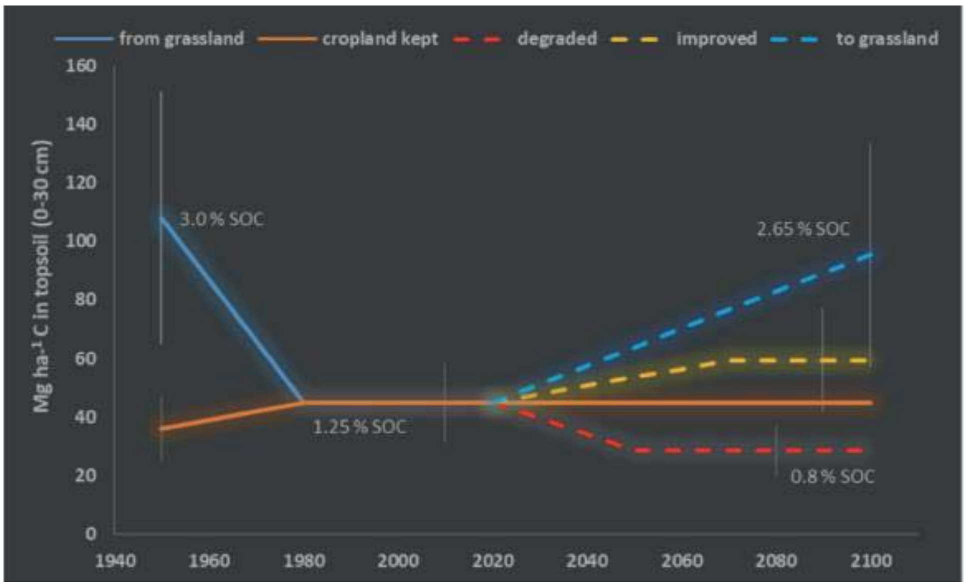
Thin and thick dotted lines correspond to contrasting climate change models. The blue line is the average, while the grey region delimited the 2σ confidence interval. Scenarios include Conversion from arable to grassland (AR_GR_LUC), Crop residue management (AR_RES), Reduced tillage (AR_RT), Ley in rotation (AR_LEY), Cover crops (AR_CC)..

Similar schematic scenarios for possible ranges of development in the soil organic carbon (SOC) stock in the topsoil (0-30 cm) with land management changes are evident in other studies. In the Fig. IV-5 below estimations are in t ha-¹ and calculated by typical initial SOC concentrations [%, mg 100 g] of a North German site, with standard deviations of 30 % and 40 % of the measured values in cropland and grassland samples, respectively and for a soil density of 1.2 g cm-3 (dry).

[204] Lugato, E., et al, Potential carbon sequestration of European arable soils estimated by modelling a comprehensive set of management practices, Global Change Biology, Vol 20, Issue 11, 2014. https://onlinelibrary.wiley.com/doi/full/10.1111/gcb.12551

Different reaction times of 30-100 years were assumed to reach a new equilibrium of SOC after land management changes. Improved management (carbon farming) might slowly improve levels back to the levels of grassland (blue dotted line) or somewhere in between (e.g., yellow dotted line)[205].

Figure IV-5 Development in the soil organic carbon (SOC) stock in the topsoil (0-30 cm) with land management changes. Source: Paulsen et al, 2020.



Increased soil carbon levels in mineral soils improves soil condition by supporting aggregate formation, which in turn improves soil structure, a key factor that governs water and gas movement within soils as well as providing an improved habitat for soil organisms. Given the crucial role of soil in the water cycle, this development is also indispensable for climate adaptation. Healthy cropland soils, with increased levels of SOC, will make the EU more resilient to weather extremes while reducing its vulnerability to climate change (e.g. increased water retention reduces flood peaks while mitigating drought conditions)[206,207].

In parallel, increased levels of organic matter provide the energy sources for soil-dwelling organisms, and thus underpinning the soil-food web, which in turn, is linked to higher soil biodiversity levels. Soil organisms are the principal drivers of nutrient cycling while regulating the dynamics of soil organic matter, soil carbon sequestration and greenhouse gas emission[208].

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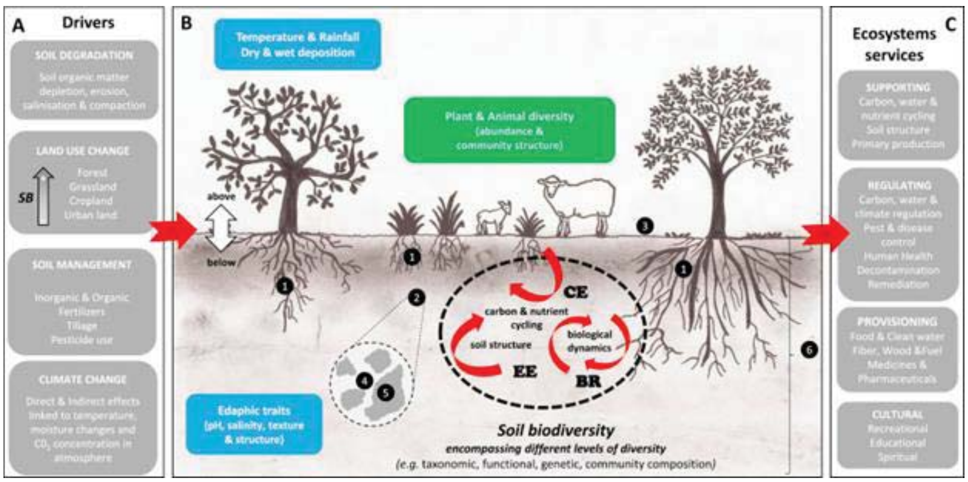
205 Paulsen (ed.) (2020). Inventory of techniques for carbon sequestration in agricultural soils. Interreg Europe, Thünen Institute of Organic Farming. 20200313-cf-rapport.pdf (northsearegion.eu)

206 American University, What is Soil Carbon Sequestration? https://www.american.edu/sis/centers/carbon-removal/fact-sheet-soil-carbon-sequestration.cfm

207 Á. Kertész, B. Madarász, Conservation Agriculture in Europe, International Soil and Water Conservation Research, Volume 2, Issue 1, 2014.https://www.sciencedirect.com/science/article/pii/S2095633915300162

208 FAO, ITPS, GSBI, SCBD, and EC. 2020. State of knowledge of soil biodiversity – Status, challenges and potentialities, Summary for policymakers. Rome, FAO. https://www.fao.org/documents/card/en/c/cb1929en

Figure IV-6 Soil biodiversity overview. Source: Mujtar et al 2019[209].



The banking and financial sector is increasingly interested in investing in those farmers who apply sustainable practices and increase soil carbon, as well as creating market-based incentives for carbon storage[210].

There is evidence that carbon farming can contribute significantly to the EU's efforts to tackle climate change but also brings other co-benefits such as increased biodiversity and the preservation of ecosystems.

The revised Regulation on Land Use, Forestry and Agriculture (LULUCF) sets an overall EU target for carbon removals by natural sinks, equivalent to 310 million tonnes of CO2 emissions by 2030. National targets will require Member States to care for and expand their carbon sinks to meet this target. By 2035, the EU should aim to reach climate neutrality in the land use, forestry

[209] El Mujtar, V., et al, Role and management of soil biodiversity for food security and nutrition; where do we stand?, Global Food Security, Volume 20, 2019. https://www.sciencedirect.com/science/article/pii/S2211912418300300
[210] Rabobank, Soil health for stronger farms? We can measure that: Helping farmers better know their soil. https://www.rabobank.com/en/raboworld/articles/soil-health-for-stronger-farms-we-can-measure-that.html

and agriculture sectors, including also agricultural non-CO2 emissions, such as those from fertiliser use and livestock.

Socio-Economic Impacts

Cost estimates from studies assessing the implementation of SOC conservation measures vary widely as studies follow different methodologies, include different soil management measures, and are based on regions with different pedo-climatic and socioeconomic contexts. Typically, values range from €100 to 1000 /ha/year with an average of around €280/ha/year.
Inaction on SOC decline costs the EU €3.4-5.6 billion every year[211]. Addressing SOC decline can avoid these large costs while delivering a range of additional on-site and off-site benefits. This target will deliver climate change mitigation benefits through increasing carbon sequestration in EU-27 agricultural land by 404 MtCO2eq by 2030 (equivalent to 0.31 tCO2eq/ha/year). Applying a carbon value of €100 per tCO2 equivalent, this would result in an economic benefit of around €40.4 billion from 2022-2030 and €31/ha/year. For specific measures, carbon stock increases range from 730 and 630 kgC/ha/year in the case of converting arable to grassland and implementing agroforestry practices respectively, to more modest increases between 15 and 30 kgC/ha/year in the case of grazing management, planting hedges, straw incorporation, and applying exogenous organic materials (EOMs).

Other considerations include biodiversity benefits by enhancing above and below ground habitat health, and increased crop yields, reduced erosion and increased water retention leading to increased resilience of agricultural production, natural hazard risk mitigation and food security. In addition, improved soil health that can benefit plant health and thus improve resilience towards droughts and increasing pests. These all lead to considerable climate adaptation benefits which may even outweigh the mitigation benefits of enhanced SOC[212,213]. In addition, measures can also reduce costs to farmers as they reduce input costs by, for example, reducing pesticide and fertilizer use.

Floods are the most common and most destructive natural disasters in Europe, resulting in a loss of life and significant economic damage. Over the past decades, the costs of floods have exhibited a rapid increase. Annual flood damage in the EU is currently estimated at €7.8 billion, affecting around 125,000 people, which could rise on the to €48 billion per year and 350,000 people by 2100 if nothing more is done to prepare[214]. There is increasing interest in the development of natural solutions to alleviate the impact of flood peaks. Increased water retention by agricultural soils is one of the options being considered with clear cost benefits[215].

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[211] European Commission (2006a) Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of Regions – Impact Assessment of the Thematic Strategy on Soil Protection. SEC(2006)620 (http://ec.europa.eu/environment/archives/soil/pdf/SEC_2006_620.pdf)

[212] Powlson, D. S., A. P. Whitmore, K. W. T. Goulding (2011) Soil carbon sequestration to mitigate climate change: A critical re-examination to identify the true and the false. European Journal of Soil Science, vol. 62, no. 1, pp. 42–55.

[213] Amundson, R. and Biardeau, L. (2018) Opinion: Soil carbon sequestration is an elusive climate mitigation tool. Proceedings of the National Academy of Sciences of the United States of America, vol. 115, no. 46, pp. 11652–11656.

[214] https://www.science.org/content/article/europe-s-deadly-floods-leave-scientists-stunned

[215] https://www.arc2020.eu/flood-protection-lets-start-with-soil/

There is a very high variation in estimated monetary benefits from SOC enhancement. A recent meta-review found soil protection measures deliver benefits ranging from 0 to 3440 €/ha/yr (average €93 €/ha/yr)[216]. Another study found overall on-site benefits from SOC conservation and enhancement on agroecosystems have been estimated at 2.1bn €/yr over 20 years in the EU-25. Carbon sequestration/preservation/farming activities can achieve several economic and environmental benefits in addition to climate change emission offsetting. Carbon farming programmes are by default long-term where annual costs will vary (e.g. schemes may call for a commitment of 25 or more years, natural events such as floods, drought or fire may disrupt schemes while climate change may reduce sequestration rates). Sequestration is probably only viable for 30-50 years (depending on soil type and location) when equilibrium is reached. Payment schemes may then have to switch to preservation.

Concerns about the excessive costs of physically measuring soil carbon stores are increasingly less relevant given a decrease in laboratory testing prices, the increasing use of spectroscopy systems as alternatives to wet chemistry, and the proposed "Test your soil for free" initiative in the new EU Soil Strategy. These measures can also be supplemented by low-cost modelling approaches.

The opportunity cost of a permanent land-use change may be negative. Most solutions are available now, at low-cost, and technology and market changes may mean that other opportunities become much more profitable in the future. Soil carbon management lends itself well to both action and results-based payment schemes of the CAP and the recently announced carbon farming initiatives[217] as well as through the Living Labs and Lighthouse initiatives of the Soil Mission "A Soil Deal for Europe".

In summary, increases of the indicator of soil organic carbon in cropland mineral soils is related to management practices, and would directly provide direct evidence of improvements in biodiversity. Based on the case examples provided a number of socio-economic benefits, beyond carbon sequestration alone, would also be expected across the EU.

Species and habitats of community interest related to agriculture

Background information

Species and habitats of community interest related to agriculture are well documented and measured as part of the reporting obligations under the Habitats Directive. However, currently, only the grassland habitats category is the subject of specific focus, with specific figures available.

This indicator assesses the conservation status trends of those habitats and species of Community interest, i.e. listed in the relevant Habitats Directive annexes, that are considered to be strongly linked to agro-ecosystems. The work on this indicator has started after the publication of the CAP proposals in 2018 and is still in progress

[216] Tepes, A, Galarraga, I, Markandya, A and Sánchez, M J S (2021) Costs and benefits of soil protection and sustainable land management practices in selected European countries: Towards multidisciplinary insights. Science of the Total Environment No 756, 143925.

[217]European Commission, Carbon Farming: https://ec.europa.eu/clima/eu-action/forests-and-agriculture/sustainable-carbon-cycles/carbon-farming_en

Species and habitats of Community interest are those in danger of disappearance in their natural range, rare or endemic, or characteristic of one or more of the EU biogeographical regions; these species and habitats are listed in the annexes of the Habitats Directive.

The long-term existence of these habitats and species is strongly linked to the presence of certain extensive agricultural management practices; their conservation status is influenced by the management practices implemented, the intensity of land use, and by the conversion into or disruption by other land uses.

Lists that identify species and habitats protected under the Habitats Directive dependent on agro-ecosystems exists since many years. The species and habitat composition will vary between biogeographical regions and between Member States. The lists of species and habitats (one per Member State with indication of the relevant biogeographical regions) are being elaborated building on the guidance from the European Commission, also taking into account Halada et al. (2011)[218] and Roscher et al. (2015)[219]. The lists are to be validated by the Member States shortly. This indicator reduces the scope to species which are not birds, and to habitats and species strictly dependent on agriculture.

Details of the indicator

The unit of measurement is the percentage of assessments with a stable or improving conservation status trend. For both, species and habitats, the overall assessment of conservation trend is as follows: 'improving +', 'deteriorating -', 'stable =', 'unknown x'.

The indicators is defined as:

Number of assessments that indicate an improving or stable trend /

Total number of assessments

The number of assessments depends on the total number of species and habitats, and on the number of biogeographical regions where they are represented (e.g. a species present in 2 biogeographic regions will have two assessments).

The data source is the reporting from Article 17 of the Habitats Directive, and it is reported to the European Environment Agency (EEA) by the Member States. The EEA would carry out the necessary calculations. The data collection level is foreseen to be applied at the level of the Member States (NUTS 0). Values are assessed at the biogeographical level of each Member State, in such a way that results can be aggregated at the level of the Member States and the EU. The frequency of the availability of the figure will follow article 17: current 2019 report due available (for 2013-2018), Next reports are due in 2025 (2019-2024) and 2031 (2025-2030).

Environmental impacts

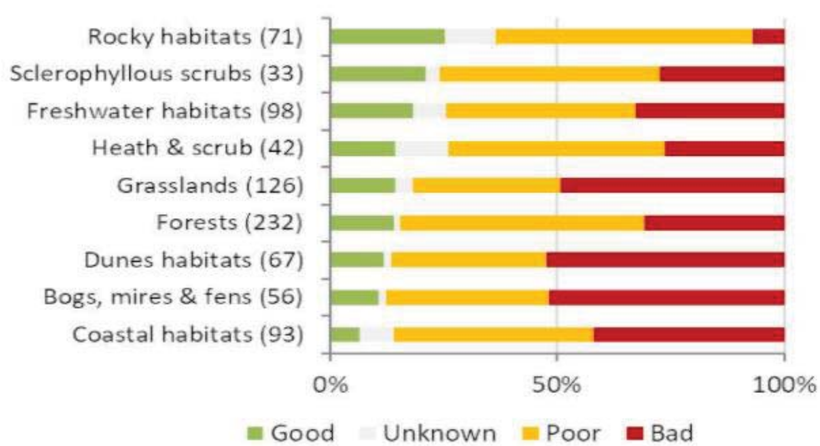
[218] Halada, L., Evans, D., Romão, C., and Petersen, J.E. (2011). Which habitats of European importance depend on agricultural practices? Biodiversity and Conservation 20, 2365- 2378.

[219] Roscher, Christiane; Weisser, Wolfgang W; Schulze, Ernst-Detlef (2015): Aboveground community and species-specific plant biomass from the Jena Experiment (Dominance Experiment, year 2004). PANGAEA.

For millennia farming has been a major contributor to biodiversity, thanks to the evolution diverse farming traditions which have resulted in the development of an intricate patchwork of semi-natural habitats across the landscape. This has, in turn, attracted a wide range of species of fauna and flora. Some are well known like the Hamster (Cricetus cricetus) and the European Ground Squirrel (Spermophilus citellus), but a myriad of other lesser known species, such as Dusky Blue Butterfly (Maculinea nausithous) and many orchid species have also made their home in these semi natural habitats. However, in the last 50 years, through the combined effects of farm intensification and land abandonment, farmland biodiversity has undergone a dramatic decline[220]. Such relatively rapid change in main agricultural management trends is a threat for a number of species and habitats that are now entirely dependent on locally tailored extensive farming systems and practices for their continued survival.

For habitats, the indicator covers for example alpine meadows and pastures, steppic plains, open heathland and wet grasslands. From the State of Nature report[221], Grasslands, which include some very species-rich habitats, are also among those with the highest proportion of 'bad status' assessments (49%). Grasslands that require active management are in a particularly bad state. For grassland habitats, mainly hay meadows , Molinia meadows and several types of semi-natural dry grasslands show a deteriorating conservation status trend, illustrating their dependence on extensive farming practices that are still in decline across the EU.

Figure IV-7 Conservation status of different habitats. Source: EEA, 2020.



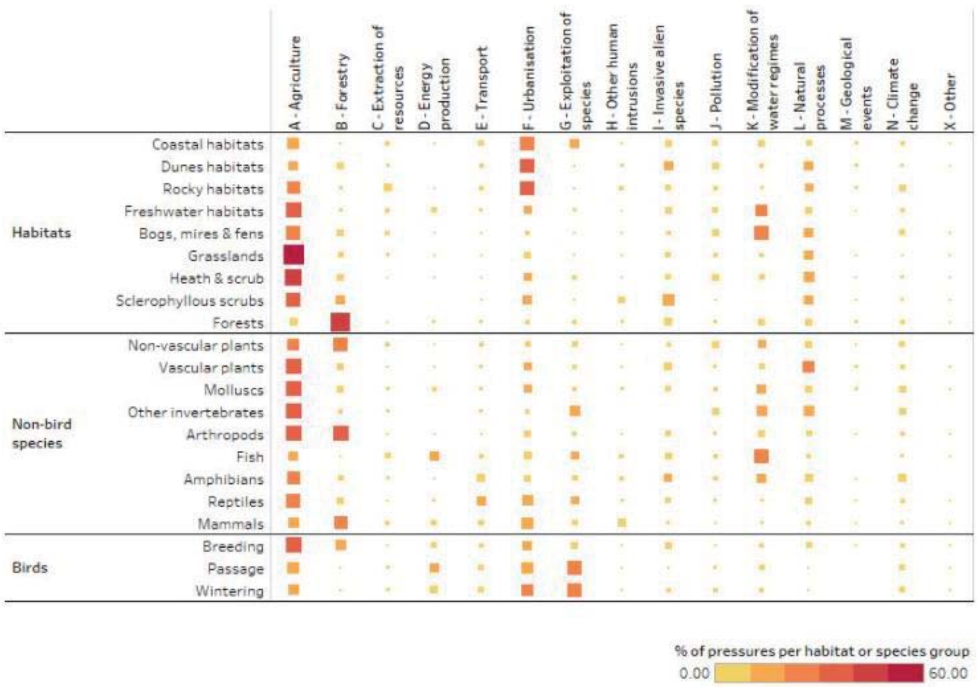
The most frequently reported pressures for both habitats and species stem from agriculture, which reflects the relative scale of agricultural land-use and changes in farming practices (intensification and abandonment of extensive agriculture). Extensive agricultural management creates and maintains semi-natural habitats with diverse fauna and flora. Since the 1950s, however, more

[220] European Commission, Farming for Natura 2000: Guidance on how to support Natura 2000 farming systems to achieve conservation objectives, based on Member States good practice experiences, 2018. https://ec.europa.eu/environment/nature/natura2000/management/docs/FARMING%20FOR%20NATURA%202000-final%20guidance.pdf

[221] Report from the Commission to the European Parliament, the Council and the European Economic and Social Committee, The state of nature in the European Union Report on the status and trends in 2013 - 2018 of species and habitat types protected by the Birds and Habitats Directives, 2020. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2020:635:FIN

intensive and specialised farming has contributed increasingly to ongoing biodiversity loss. Grasslands, freshwater habitats, heaths and scrubs, and bogs, mires and fens have been most severely affected. Semi-natural habitats depending on agriculture, such as grasslands, are particularly threatened and their conservation status is significantly worse than for other habitat types that do not depend on agriculture (45% are assessed as bad, as compared with 31% for other habitats). Compared to 2015, assessments of agricultural habitats show an overall deterioration in conservation status: good status decreased from 14% to 12% and bad status increased from 39% to 45%. Only 8% of agricultural habitats show an improving trend, whereas 45% are deteriorating. Many species of birds, reptiles, molluscs, amphibians, arthropods and vascular plants are also impacted and farmland biodiversity continuous to decline. Therefore evidence of increase of this indicator would provide evidence of direct benefit to biodiversity.

Figure IV-8 Distribution of level-1 pressure categories among habitats, non-bird species and birds. Source: EEA, 2020.



Socio-Economic Impacts

Most of the species and habitats covered by the indicator concern extensive farming well adapted to local conditions. These are mostly local small-scale farmers rather than large agri-businesses. However, they are far from being in the minority. Small scale farmers and extensive farming businesses still represent a significant proportion of the 14 million farmers in the EU. Some of these existing farming systems and practices are already compatible with conservation of the species and habitats. Although not as productive as the modern large scale farms, these farming systems are nevertheless a vital part of the socio-economic fabric of Europe’s rural areas and, as such, have an essential role to play socially, economically and environmentally within the EU.

They represent a substantial source of local employment and income, preventing rural depopulation and helping to keep rural communities alive. The report for DG ENV (BIO Intelligence Service 2011) estimated that Natura 2000 directly and indirectly supported some 1.3 million FTE jobs in the agricultural sector each year in the EU-27 during the period 2006-2008222. They are a vital source of food and produce for many remote rural areas. And they play a major role in maintaining Europe's rich and diverse biodiversity. However, despite their socio-economic importance, the viability of extensively managed farming businesses has become increasingly precarious over the years. In many parts of the EU, farmers have been forced to abandon their land and go in search of alternative sources of income elsewhere, with devastating social and economic consequences for the rural areas concerned. Or they have further intensified their land, converting grassland to arable, increasing the livestock stocking rate, or increased fertilization. Over recent decades substantial areas of the EU have been affected by agricultural abandonment. There are also reasonable expectations that farmland abandonment in Europe, particularly of extensively grazed areas, will continue over the next decades.

These illustrations therefore point to the kinds of socio-economic benefits that can be expected when there is evidence of increase of the indicator of the Species and habitats of community interest related to agriculture.

Overall analysis of the indicators

The purpose has been to examine and justify which indicators that demonstrate the enhancement of biodiversity for agroecosystems could be considered for inclusion in the legal proposal. To this end, a broad number of potential indicators were first identified and a set of criteria were developed to select the most promising. From the original broad set of indicators a set of four were identified as the most adequate. This was followed by an assessment of the environmental and socio-economic impacts, that increases in these indicators would entail.

The indicators selected and analysed each constitute different ways of representing the enhancement of biodiversity in agroecosystems. They focus on either on key indicator species (such as butterflies) or aspects of the habitats themselves. A consideration of organic content in grassland and cropland soils is complemented by "above ground" aspects such as due to landscape features. This is further complemented by a consideration of those habitats or species that are in danger of disappearance. In this way, together, the indicators provide complementary information on the presence of biodiversity. Furthermore, increases in these indicators clearly provides evidence of improvement in trends in biodiversity as such as well as other environmental benefits.

The evidence provided also shows that improvements in the set of indicators would also would reflect a range of socio-economic benefits. Associated administrative costs would be relatively small since each of these indicators are already well documented and monitored. Such socio-economic benefits are a reflection of the having increases in specific indicators species (such as

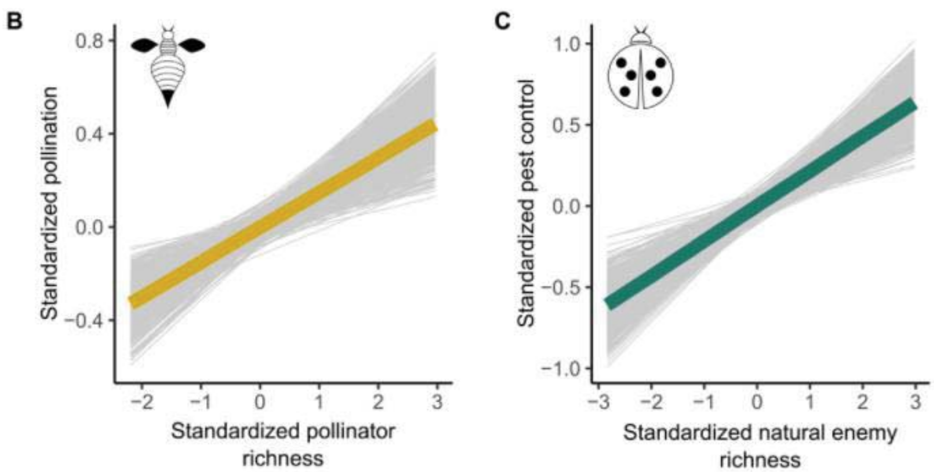
[222] https://ec.europa.eu/environment/nature/natura2000/pdf/Natura2000_and_jobs_main%20report.pdf page 19

butterflies) or evidence of good condition of aspects agro-ecosystems (such as specific agroecosystem habitats or soils).

Together with other targets considered in this Impact Assessment such as on pollinators or farmland birds, this set provides a robust set of indicators and targets that describe biodiversity in agro-ecosystems in a holistic and complementary manner. These together offer a rich set of opportunities for ecosystem management that enhances biodiversity-rich agroecosystems that maintain ecological processes that affect the co-production of a range of ecosystems services and benefits top society[223].

This is also consistent with scientific findings of the broad and multiple ecosystem service benefits of species biodiversity in agro-ecosystems. As mentioned in previous sections, studies have found evidence that richness of service-providing organisms positively influenced agroecosystem ecosystem service delivery[224,225,226]. Figure IV-9 and IV-10 below illustrate the benefits of standardized pollinator and natural enemy richness on pollination and pest control, which are essential ecosystem services for crop production[227]. On the other hand, landscape simplification reduced both pollinator and natural enemies of pests, which had consequences for pollination and pest control and, in turn, decreased crop production.

Figure IV-9 (B) Global effect of pollinator richness on pollination (n = 821 fields of 52 studies). (C) Global effect of natural enemy richness on pest control (n = 654 fields of 37 studies).



[223] Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. https://doi.org/10.5281/zenodo.3831673. Chapter 2.3

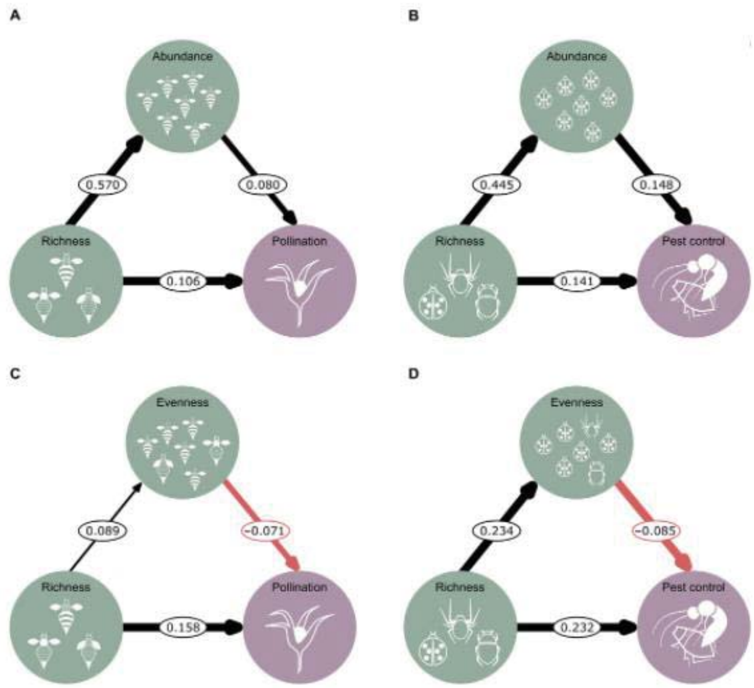
[224] Albrecht, M., et al (2020). The effectiveness of flower strips and hedgerows on pest control, pollination services and crop yield: A quantitative synthesis. Ecology Letters, 23(10), 1488– 1498.

[225] Marja R, Kleijn D, Tscharntke T, et al (2019) Effectiveness of agri-environmental management on pollinators is moderated more by ecological contrast than by landscape structure or land-use intensity. Ecol Lett 22:1493–1500. https://doi.org/10.1111/ele.13339

[226] England JR, O'Grady AP, Fleming A, et al (2020) Trees on farms to support natural capital: An evidence-based review for grazed dairy systems. Sci Total Environ 704:135345. https://doi.org/10.1016/j.scitotenv.2019.135345

[227] Da Silva, F., et al, Virtual pollination trade uncovers global dependence on biodiversity of developing countries, Science Advances, 7, 11, (2021).

Figure IV-10 Direct and indirect effects of pollinator and natural enemy richness on ecosystem services (pollination and pest control). Source: Dainese, Matteo, et al, 2019[228]



This overall points to the need for a number of *different aspects of biodiversity* (as evidenced by a set of different types of indicators) that need to improve *together in tandem* in order to optimise benefits, and is vital to sustain the flow of key agroecosystem benefits to society. Thus the set of indicators analysed here and targets considered in this Impact Assessment in particular on pollinators or farmland birds, provides a robust set of indicators and targets that can describe biodiversity enhancement in agro-ecosystems in a holistic and complementary manner.

Based on the evidence provided in these sections, one can conclude that introducing an obligation in the nature restoration law for Member States to provide evidence of increasing trends for the set of indicators analysed that describe enhancement of biodiversity, would provide overall important benefits to the environment, society and the economy.

[228] Dainese, Matteo, et al. "A global synthesis reveals biodiversity-mediated benefits for crop production." *Science advances* 5.10 (2019): eaax0121.

5. Steppe, heath, scrubland, dune and rocky habitats

5.1 Scope

This ecosystem impact assessment covers 62 types of steppe, heath, scrub, dune and rocky habitats listed in Annex I of the Habitats Directive (HD. These include 21 **steppe, heath and scrub habitat types** (excluding wet heaths and those dependent on agricultural management, which have been included respectively in the groups "wetlands" and "'agricultural habitats and grasslands"), which cover **80 894 km^2** over the whole EU-27, yet this includes significantly overestimated data from Romania. Over the other 26 EU Member States the habitats cover 78 582 km^2 (2 % of the EU terrestrial area). These areas are mainly present in the Mediterranean region and most mountain ranges, including those of Fennoscandia. The Member States with the highest proportion of these habitats are Greece, Malta, Spain, Sweden and Austria. Although the 21 types of steppe, heath and scrub habitats listed in Annex I of the HD cover a large proportion of steppe, heath and scrub habitats, a substantial area of these habitats fall outside the Annex I definitions and standards. Scrub and/or herbaceous vegetation associations cover 163 270 km^2 according to Corine Land Cover estimates from 2018, whilst there are 114 777 km^2 of heathland, scrub and tundra based on the Ecosystems map[229]. This suggest that there are between about 34 000 and 82 000 km^2 which fall outside the Annex I definitions and standards, although some of this can be expected to be Annex I wet heath and dry heath not covered in this impact assessment.

This assessment also includes a group of 41 **'dune and rocky habitat types'**, comprising sea cliffs, beaches, and islets (8 types), coastal and inland dunes (21 types), and rocky habitats (12 types). These habitats are widely distributed across the EU particularly along coastlines, in mountain ranges, and inland sandy plains. In total they cover **65 135 km^2** (excluding areas reported by Romania, which are known to be largely overestimated), which is 1.7% of the EU terrestrial area.

Due to differences in nomenclature and spatial resolution, it is not straightforward to compare the HD Annex I area data for dune and rocky habitats with Corine Land Cover (CLC) data. Nevertheless, the CLC category 'Open spaces with little or no vegetation', includes a similar set of habitats: beaches, dunes, sandy plains, bare rocks, sparsely vegetated areas and glaciers and permanent snow. The total CLC 2018 for these habitats was 62 554 km2, which indicates that a very high proportion of these types of sandy, rocky and icy habitats are covered by the list of HD Annex I habitat types.

Detailed data on the geographical distribution, area (km²), conservation status and condition of steppe, heath, scrubland, dune and rocky habitat types of Annex I of the Habitats Directive in EU Member States is provided in Annex VIII-d and -e.

5.2 Problem, current trends and ecosystem-specific baseline

Steppes, heathland and scrublands

Europe's steppes, heathlands and scrublands have declined by over 90 % since 1800s[230]. In recent decades, rates of loss have declined greatly (probably in part due to better protection), but declines

[229] https://www.eea.europa.eu/themes/biodiversity/mapping-europes-ecosystems
[230] Maes et al. (2020) Mapping and Assessment of Ecosystems and their Services.

continue. According to the baseline assessment for 2030, over the 2000 – 2018 period, net losses amounted to about 1.2 % (i.e. 0.07 % per year). It seems possible that some drivers of loss may increase, such as land take for housing and developments, abandonment and afforestation, but these may be counteracted by increased protection and funding for appropriate management. Member State data on threats to Annex I habitats and land cover flows all suggest that under existing measures, the extent of heath and shrublands ecosystems will continue to decline at similar rates as they have over recent decades. Therefore, the same rate of loss is assumed for this impact assessment, i.e. **loss in habitat area of 0.07 % per year**.

Member States' reports under Article 17 HD on the condition of the relevant habitat types indicate that at least 8.4 % of the 21 HD Annex I steppe, heath and scrub habitats area (excluding Romania) is in a not-good condition. 36.4 % of the area is reported as in 'unknown' (or not reported) condition. This means that as much as 44.8 % of the total area of these habitats could be in a poor condition if all the 'unknown' is assumed to be 'not-good'. This would be very unlikely, and therefore the true proportion of the area in a poor condition is probably closer to the proportion of the area for which Member States reported on the condition of the habitat that had a not-good condition, which is 13.2 % [231]. More than 10% of habitats assessments show deteriorating trends in condition, compared to improving trends in only 3% of assessments.

In addition, based on the data officially reported by Member States under Article 17 HD, it is estimated that a strict minimum of 400 km^2 would need to be re-created to achieve a 'favourable area'. Nonetheless, it is noted that the actual area that needs to be re-created is expected to be much higher since several Member States did not provide quantitative estimates of their 'favourable area'.

According to the same Member States reports, the top three groups of pressures affecting HD Annex I steppe, heath and scrub habitats are:

i. Conversion and land use change due to development of urban, industrial and leisure sites, from agriculture intensification, afforestation, and from building of roads and railroads.

ii. Habitat management with over 23 % of all pressures, which include inappropriate agricultural practices, such as intensive grazing or the abandonment of extensive grazing (73 %); or inappropriate forestry practices, such as burning, or the planting of non-native species (20 %).

iii. Invasive alien species and problematic species, many of them of EU concern.

In addition to these, natural processes also are placing great pressures on these ecosystems, mainly originating from natural succession, which is often related to the lack of management of the concerned habitats.

[231] 50 009 km^2 with a reported condition, of which 6 586 km^2 had a 'not-good' condition.

The baseline assessment to 2030 also indicates that the main pressures affecting the condition of steppe, heath and shrub ecosystems are expected to continue. However, there is limited information on possible changes in the main drivers of pressures that could lead to increases in degradation or recovery. Some of the most important pressures such as land abandonment and large or intense fires are expected to increase, and be exacerbated by climate change, particularly in the Mediterranean region. Some pressures may also be countered to some extent by improved and wider management and restoration, especially within Natura 2000 sites. But this will also depend on many factors, including the outcome of the CAP reform, and whether sufficient funding will be directed to seminatural habitats such as scrubland and heathland by Member States. Given the uncertainties, it is assumed that degradation levels for HD Annex I steppe, heath and scrub habitats will not change under the baseline scenario to 2030, and therefore that 13.2 % (6 586 km^2) of the habitat area would require restoration.

Dune and rocky habitats

According to the EU Ecosystem Assessment[232], sparsely vegetated lands (which include bare or sparsely vegetated rock, lava, ice and snow of cliffs, screes, caves, volcanoes, glaciers and snow-fields, dunes, beaches and sand plains) can be reduced due to land take, such as for leisure and tourism. Climate change is also leading to the retreat of glaciers and snow-fields, and dunes and beaches are declining as a result of sea level rise and storms; although losses have been a small proportion of the habitat area until now. Overall land take trends have declined over the long- and short-term. The net effect of factors affecting sparsely vegetated lands has been an increase of 1.5 % between 2000 and 2018 (0.08 % per year), due to an increase in burnt areas. Future trends in the overall area of HD Annex I dune and rocky habitats are uncertain, but changes are likely to continue to affect a very small proportion of the habitat. In the absence of reliable information, **it is assumed that the overall area of HD Annex I dune and rocky habitats will remain approximately stable to 2030**.

The Member States' reports (based on Article 17 of the HD) for 2013-2018, indicate that at least 6 619 km^2 (10.2 %) of the 41 HD Annex I dune and rocky habitats area (excluding Romania) is in a not-good condition. However, a large proportion (43.7 %) of the area is reported as in 'unknown' (or not reported) condition. This means that as much as 55.9 % of the total area of these habitats could be in a poor condition. The more likely proportion of the area in a poor condition is the area for which Member States reported on the condition of the habitat that had a not-good condition, which is 18.05%, equating to 11 756 km^2.

In addition, it is estimated that a strict minimum of 355 km^2 of dune and rocky HD Annex I habitats would need to be re-created to achieve a 'favourable area'. This comprises 223 km^2 for coastal and inland dunes (particularly for priority habitat 'Pannonic inland dunes), 111 km^2 for rocky habitats and 22 km^2 for cliffs, beaches, and islets habitats. As for heaths, etc. the actual area that needs to be re-created is expected to be much higher since several Member States did not provide quantitative estimates of their 'favourable area'.

232 Maes et al. (2020) Mapping and Assessment of Ecosystems and their Services.

The Member States' Article 17 reports indicate that the top three groups of pressures affecting HD Annex I dune and rocky habitats are:

i. Sports, tourism and leisure activities (reported as a high pressure in 12% of assessments).
ii. Natural succession and agricultural abandonment (reported as a high pressure in 12% of assessments).
iii. Invasive alien species (reported as a high pressure in 11% of assessments).

All other pressures with high impacts were reported in less than 5% of assessments.

It is highly likely that all the main pressures affecting dune and rocky habitats will continue, but there is insufficient information available to reliably draw conclusions on future trends or quantify changes in pressures, or the overall condition of the habitats. It is therefore assumed that under the baseline scenario, the amount of habitat requiring restoration and re-creation would remain the same as current levels in 2030.

5.3 Target options screened in/out

As the rationale and context for restoration of these habitats is relatively straightforward and established, the following two related targets (with varying ambitions) are examined in this impact assessment, and no alternatives are considered.

> A) Restore all HD Annex I steppe, heath, scrub, dune and rocky habitats to good condition, with all necessary restoration measures completed on 30 % (or 15 %) of degraded areas by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.
>
> B) Recreate 30 % (or 15 %) of additional habitat area required to achieve Favourable Conservation Status of HD Annex I steppe, heath, scrub, dune and rocky habitats by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.

As a result of the high importance of steppe, heath,scrub, dune and rocky habitats for EU protected species, including birds, many of which are declining, it may be appropriate to have a related, but separate, target for EU protected species. The most obvious aim of the target would be linked to the achievement the favourable / secure status of the species concerned, as this would link directly to the objectives of the Birds and Habitats Directives. In particular, the target would concern the species' habitats restoration/recreation needs to achieve favourable / secure status of the species concerned, while other conservation action would be implemented under existing legislation.

Given the above rationale, the following complementary target for EU protected species that are predominantly associated with steppe, heath, scrub, dune and rocky habitats is considered in this impact assessment:

> C) Restore and re-create steppe, heath, scrub, dune and rocky habitats as necessary to achieve the favourable conservation status of wild birds and species that are listed in Annex II, IV and V of the Habitats Directive and predominantly associated with steppe, heath and

scrub habitats, with 30 % (or 15 %) of all necessary actions carried out by 2030 and 60 % (or 40 %) by 2040 and 100 % by 2050.

This target would complement the above targets based on Annex I habitats, as it would also cover the areas of steppe, heath, scrub, dune and rocky habitats not falling under Annex I definitions and standards, which are not negligible for steppes, heath and scrub habitats, as mentioned above.

5.4 Impacts of assessed target options

The costs of restorationwere estimated by calculating the area of degraded ecosystems to be restored and re-created annually to meet each target and applying average per hectare capital costs for restoration and re-creation, and annual costs for maintenance taken from Tucker et al. [233] The costs of restoration and re-creation include the capital costs of actions such as tree and scrub removal, invasive species control and vegetation re-establishment. Maintenance costs include low intensity grazing management. The per hectare costs of the dunes and rocky habitats group are only based on the costs of dunes, as data on the costs of other habitat types in the group are lacking. However, they are expected to be of similar or lower unit costs. For most habitats, the required management will be undertaken largely by private landowners and land managers, in return for incentive payments, a large proportion of which include compensation for opportunity costs relating to land management (e.g. income forgone through reduced grazing, or habitat creation on cropland). Maintenance costs were applied to the entire ecosystem area, since meeting the targets requires further degradation of ecosystems to be avoided. The costs of restoring caves, lava fields, and glaciers are not estimated as few specific management and restoration measures are feasible for these habitats. Instead they mainly require protection through regulation and/or general measures to reduce pressures, such as from water pollution and climate change.

Benefits estimates were based on an extensive review of literature of the value of benefits of these ecosystems, which identified changes in per hectare values of ecosystem services for restored vs degraded ecosystems. The analysis applied estimates of the median per hectare value of carbon storage and sequestration values and total ecosystem service benefits of ecosystem restoration derived from values obtained from 15 studies. Per hectare benefits estimates were applied to the area of ecosystem restored to give annual estimates of total benefits. Annual cost and benefit estimates were discounted, applying a 4% social discount rate, and summed to calculate their total present value. This enabled total net present value (benefits – costs) and benefit: cost ratios to be calculated.

The estimated costs of achieving good condition of HD Annex I steppe, heath, scrub, dune and rocky habitats are summarized in Table V-1. The costs are broadly based on the area of habitat that is in not-good condition or affected by specific pressures, multiplied by the costs of key measures to maintain the habitat, address the pressures thereby restoring the habitat, and re-creating habitat. The costs are additional to those associated with measures that are already in place (for example CAP measures). Also, to avoid double-counting, they do not include general

[233] Tucker et al., (2013) Estimation of the financing needs to implement Target 2 of the EU Biodiversity Strategy. Report to the European Commission. Institute for European Environmental Policy, London. Available at: https://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/Fin%20Target%202.pdf

supporting measures (e.g. creation of restoration plans), administration and monitoring costs, or broad actions that apply to multiple ecosystems, such as the need to reduce nitrogen deposition below critical levels.

Information on the costs of maintaining and restoring steppe, heath, scrub, dune and rocky habitats for EU protected species is insufficient to be able to calculate the costs of habitat restoration and re-creation necessary to achieve their favourable conservation status. Nevertheless, additional costs can be expected to be low for Annex I areas, as the achievement of favourable conservation status for habitats should also largely achieve the favourable conservation status of associated species.

Table V-1: Summary of projected costs (EUR) of achieving restoration targets for HD Annex I steppe, heath, scrub, dune and rocky habitats in relation to current trends & expected 2030 baseline

Targets 15 % and 40 %[234]

Period	% Full restoration	Maintenance costs	Restoration costs	Re-creation costs	Combined costs	Total over period
Average annual costs						
2022-2030	15 %	398 481 938	19 508 067	3 270 017	421 260 022	3 791 340 200
2031-2040	40 %	401 901 938	29 262 101	3 525 332	434 689 371	4 346 893 707
2041-2050	90 % [235]	407 601 938	58 524 202	4 667 557	470 793 697	4 707 936 969
Cost over full period (29 years)						
2022-2050	90 %	11 681 376 194	1 053 435 637	111 359 046	**12 846 170 877**	

Targets: 30 % and 60 %

Period	% Full restoration	Maintenance costs	Restoration costs	Re-creation costs	Combined costs	Total over period
Average annual costs						
2022-2030	30 %	398 481 938	39 016 135	4 075 800	441 573 873	3 974 164 857
2031-2040	60 %	405 321 938	35 114 521	3 793 647	444 230 106	4 442 301 061
2041-2050	90 %	412 161 938	35 114 521	3 793 647	451 070 106	4 510 701 061

[234] Although the 2050 target aims to restore 100 % of the habitat, the 2050 cost estimation is for 90 % restoration as this is the maximum percentage that can be expected in practice. Furthermore, an extrapolation of current restoration costs would no longer provide reliable estimates in the range between 90 and 100 %.

[235] Although the 2050 target aims to restore 100 % of the habitat, the 2050 cost estimation is for 90 % restoration as this is the maximum percentage that can be expected in practice. Furthermore an extrapolation of current restoration costs would no longer provide reliable estimates in the range between 90 and 100 %.

Cost over full period (29 years)					
2022-2050	90 %	11 761 176 194	1 053 435 637	112 555 146	**12 927 166 977**

The costs of restoration will be incurred by landowners and land managers, who should in turn be compensated through incentive payments funded by the taxpayer. The funded restoration works will create employment and enhance incomes for land managers and contractors.

Restoration will deliver substantial benefits for biodiversity, society and the economy, through the delivery of enhanced ecosystem services. These include provisioning services (maintenance of sustainable grazing), regulating services (e.g. carbon storage and sequestration, coastal flood protection, wildfire prevention and erosion control) and cultural services (including landscape, recreation and tourism, as well as existence values). Beneficiaries will include society, as well as sectors such as farming and tourism.

Concerning the benefits associated to restoration, based on the evidence available, we estimate median values for steppe, heath and scrub restoration and re-creation of €348 ha/yr (carbon sequestration and storage) and €2 120 ha/yr (total ecosystem service values). These median values are taken from studies which give a wide range of benefits estimates, as summarised in the table below. Benefits for dune and rocky habitats were not assessed, due to time constraints.

Table V-2: Summary of Benefits Estimates from Ecosystem Restoration of steppe, heath and scrub habitats

Ecosystem	Service valued	Range (EUR ha/year)	Median estimate (EUR ha/year)
Heathland and scrubland	Carbon sequestration and storage	232 – 1 337	348
	Multiple ecosystem services	558 – 9 580	2 120

The value of the benefits has been estimated in monetary terms by multiplying the median values in Table V-2 by the areas of habitat restored and re-created. The benefits of restoring Annex I steppe, heath and scrub habitats are estimated to exceed the costs, even in a scenario where only carbon benefits alone are considered. Benefit cost ratios of meeting targets are estimated at 1.3-1.5:1 based on carbon benefits alone, and 7.9-9.2:1 if the total value of enhanced ecosystem services is considered.

Table V-3: Benefits and costs of restoration of steppe, heath and scrub habitats (present values[236], M EUR, 2022-2070)

Note: The cost-benefit analysis does not include costs and benefits for dune and rocky habitats, since time constraints did not allow for the assessments of benefits.

	15 % /40 % / 90 % Target	30 % /60 % / 90 % Target
COSTS		
Maintenance	2 777	2 799
Restoration	227	265
Re-creation	46	48

[236] For the purpose of making a cost-benefit analysis, values are presented in present values (i.e. with discount factor applied).

TOTAL (full recovery)	**3 051**	**3 111**
BENEFITS (full recovery)		
Carbon only	3 971	4 722
Total Ecosystem Services	24 191	28 768
Net Present Value (full recovery)		
Carbon only	920	1 611
Total Ecosystem Services	21 140	25 657
Benefit: Cost Ratio (full recovery)		
Carbon only	1.3	1.5
Total Ecosystem Services	7.9	9.2

5.5 Synthesis

Table V-4 provides a summary of the analysis of options and conclusions in relation to the effectiveness, efficiency, coherence, and proportionality of each target.

Table V-4: Overview table assessing options on EU impact assessment criteria

	Habitats Directive Annex I steppe, heath, scrub, dune and rocky habitats	**EU protected species of steppe, heath, scrub, dune and rocky habitats**
Feasibility / effectiveness	High feasibility and potential for restoration and re-creation (for most habitats), and effective at increasing biodiversity and ecosystem services	Uncertain due to limited information on restoration needs for the protected species associated with the habitat, but probably high feasibility.
Efficiency	Restoration delivers benefits for biodiversity and people, including a wide range of regulating, cultural and provisioning services. Benefits for carbon sequestration alone are estimated to exceed costs by a factor of 1.5:1. Total ecosystem service benefits are estimated to exceed costs by a factor of 8:1.	Insufficient evidence available to quantify, but expected to provide significant indirect benefits from the measures needed to restore the habitat (e.g. reducing large wildfires).
Coherence	Full coherence with EU environmental policies and climate goals. Potential to make significant contributions to climate mitigation, and climate adaptation. Overlaps with species target.	Full coherence with EU environmental policies and climate goals. May indirectly contribute to climate adaptation and mitigation. Overlaps with Annex I habitats target and with targets for pollinators (separate IA).
Proportionality	High due to high importance of the habitats for biodiversity and associated ecosystem services	Uncertain, due to unknown costs, but probably high because of the high importance of steppe, heath and scrub for EU protected species, including birds, many of which are declining
Conclusion	**Include as a target, with high priority**	**Include as a target, with high priority (even if quantified cost/benefit analysis could not be performed)**

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PART 5/12

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

ANNEX VI-b

Accompanying the

proposal for a Regulation of the European Parliament and of the Council

on nature restoration

{COM(2022) 304 final} - {SEC(2022) 256 final} - {SWD(2022) 168 final}

EN EN

Annex VI: Analysis by ecosystem

(VI-b: Chapters 6-10)

Summaries of Impact Assessments of ecosystem-specific EU restoration targets

Because of its size, annex VI is split in two parts. Chapters 1-5 are in annex VI-a:

1. **Inland wetlands**
2. **Coastal and other saline wetlands**
3. **Forests**
4. **Agro-ecosystems**
5. **Steppe, heath, scrubland, dune and rocky habitats**

Table of contents of VI-b:

6. Freshwater: Rivers, lakes and alluvial habitats

6.1 Scope

The freshwater ecosystems of Europe comprise habitats mainly dominated by plants that are strictly aquatic, emergent, or amphibious, or by grasses or herbs that are adapted to occasional floods and able to develop during dry periods. Freshwater habitats are widely distributed across Europe but vary in character and distribution according to climatic and geomorphological conditions. Permanent water bodies are mainly concentrated in the northern and Atlantic regions, while the temporary ones are more typical in areas with a Mediterranean climate. Some of these habitats can be part of very broad ecosystems (like long rivers or large lakes), while others occur as small and localised patches (like springs or ponds). Natural or anthropogenic supplies of nutrients and minerals are important factors determining the species composition of the biotic part of most freshwater habitats, which can thus be grouped according to their trophic level: they can be oligotrophic, mesotrophic, eutrophic or dystrophic, or exhibit a range of such conditions.

According to the Mapping and Assessment of Ecosystems and their Services (MAES) framework, river and lake ecosystems comprise the following EUNIS habitats[1]:

- C1 Surface standing waters (Lakes, ponds & pools, permanent lake ice)
- C2 Surface running waters (Springs, upstream tidal and non-tidal rivers including temporary ones)
- C3 Littoral zone of inland surface water bodies (Various vegetation types in around freshwater)

All EU Habitats Directive Annex I lake and river habitat types (codes 31xx and 32xx) are included within the scope of this thematic Impact Assessment (IA). Acknowledging that rivers are wider than the channel associated to them, riverbanks and areas next to rivers, which may be covered by water only during floods, are also considered as part of the river system and therefore the scope of this IA also includes Habitats Directive Annex I habitats covering alluvial forests- and meadows. Floodplains acting as interface between catchment and the river are an important ecological part of the system and its healthy functioning and are therefore also part of the river ecosystem.

Detailed data on the geographical distribution, area (km²), conservation status and condition of rivers, lakes and alluvial habitat types of Annex I of the Habitats Directive in EU Member States is provided in Annex VIII-f.

6.2 Problem, current trends and ecosystem-specific baseline

Freshwater ecosystems deliver a wide range of ecosystem services, providing water for drinking, energy infrastructure cooling, irrigation, the provision of fish, flood protection, water purification and recreational, cultural, and spiritual values. In addition, freshwater ecosystems play a critical role in adaptation to climate change, as projected changes in seasonal and annual flood patterns, water availability and dilution capacity will affect the functioning and societal reliance on services

[1] The EUNIS habitat classification is a comprehensive pan-European system for habitat identification. The classification is hierarchical and covers all types of habitats from natural to artificial, from terrestrial to freshwater and marine. The habitat types are identified by specific codes, names and descriptions. The full EINIS https://eunis.eea.europa.eu/habitats-code-browser.jsp

obtained from such ecosystems. Floodplains play an integral role in water retention, particularly when such habitats are maintained in good condition and unhindered from human interventions such as soil sealing, and alterations made to the flow of rivers, thus providing flood prevention and mitigation services. Lastly, freshwater ecosystems provide key services purifying water and recharging groundwater supplies, essential for the EU's drinking and agriculture water supply.

Many of the ecosystem services provided by freshwater ecosystems in the EU rely upon them being in good status and the waters of good quality, but only 38 % of surface waters are in good chemical status, and 40 % of surface waters are in good ecological status/potential[2]. When it comes to the conservation status of Annex I lake and river habitats of the Habitats Directive, 22 % of habitats assessment show a not good status, and more than 22% of assessments show deteriorating trends compared to previous reports compared to improving trends in only 4,5% of assessments. Adding to the poor status of a significant proportion of water bodies and habitats, a significant proportion of assessments, for both the Water Framework Directive and the Habitats Directive reporting on freshwater habitats, report an unknown status, which could mean that the extent of degraded ecosystems may currently being underestimated.

The first EU Ecosystem Assessment described several pressures affecting freshwaters[3]. While certain pressures have been decreasing over time, as policy measures have taken effect, others have continued to increase including land take of floodplains, diffuse source of pollution, such as nutrients from agricultural sources, and over-exploitation. As outlined in the European Waters Assessment[4], which is based on data reported under the EU Water Framework Directive, hydromorphological pressures, which alter aquatic habitats and hydrology, are the most common pressure for surface waters, affecting 40 % of water bodies. Barriers, obstacles, and transverse structures are examples of hydromorphological pressures that disturb river continuity, alter the flow and modify the habitats. Reporting under the Habitats Directive allowed the identification of the top three groups of pressures (in percentage of the total) on river, lake, alluvial and riparian habitats Annex I habitats. These are:

- **Modification of hydrology and hydro-morphology** accounting for over **33 %** of all pressures; this includes e.g. drainage, water abstraction, and dams and reservoirs;
- **Pollution** from different origins close to **22 %**; from these, over two-thirds (67 %) is originated from agriculture activities, about 18 % from mixed sources and 12 % from residential, industrial, and recreational activities;
- **Habitat management**, with over **18 %**; these include inadequate agricultural practices like under or over grazing and mowing (32 %), forestry practices such as logging and removal of dead and old trees (44 %), mineral extraction (14 %) and freshwater fish and shellfish activities (9 %)[5].

[2] According to the latest water status reporting under the Water Framework Directive.
[3] Maes et al. (2020). Mapping and Assessment of Ecosystems and their Services: An EU ecosystem assessment, EUR 30161, EN, Publication Office of the European union, Ispra, 2020.
[4] EEA (2018) European waters Assessment of status and pressures 2018.
[5] EEA (2018) European waters Assessment of status and pressures 2018.

While restoration actions are, either implicitly or explicitly, required under the EU water and nature legislation, to achieve the policy objectives, and while data on current ecosystem maintenance and restoration efforts in the EU is incomplete, studies have indicated that current restoration activity is significantly below what would be required to fulfil policy objectives[6].

6.3 Target options screened in/out

Table VI-11 below presents a short summary of the options screened for the freshwater ecosystem impact assessment, highlighting which options were retained for further analysis.

Table VI-1 Summary table screened target options

Target option	Screened in/out for assessment	Key reason(s) for screening in/out
Restore all HD Annex I freshwater habitats to good condition, with all necessary restoration measures completed on 30 % (or 15 %) of degraded areas by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050.	**Screened in –** the target would require MS to restore at least 15 % of the area of degraded habitats to achieve good condition. The target would apply to all freshwater habitats listed under the Habitats Directive (32 habitats), using the reporting frameworks currently in place for this Directive. The target would aim to improve condition status of freshwater habitats, whilst also improving the data availability on their condition.	Good conditions of a habitat refer to its structural and functional condition, which includes biological as well as abiotic factors, covering components under the HD and WFD. The good condition is one of the pillars required to achieve Favourable Conservation Status (FCS) under the HD. The aim of the target is to take the restoration actions on at least 15 % of degraded freshwater habitat area by 2030 required to achieve good condition. Important here is that the restoration of particularly floodplains will directly assist in the achievement of the BDS 2030 free-flowing river target, as it ensures that lateral connectivity is restored. We recognize that degradation of habitats can be significantly different between regions. However, since the restoration action covers a percentage, it will count for all Member States and as such, those with the largest area of degraded habitats will also have the largest effort.
Re-create area as necessary to achieve Favourable Conservation Status of HD Annex I rivers, lakes, and alluvial habitats at national biogeographical level by 2050, with 15 %(30%) achieved by 2030 and 40 %(60%) by 2040.	**Screened in**- the target is largely intertwined with the option above, yet this option target would specifically require re-creation of freshwater habitats to consider habitats which have been lost (for example, to other economic activities such as agriculture).	The target is linked to the target above- providing a means of synergistically achieving good condition of freshwater habitats. The option considers areas that have been lost and require recreation. Data gaps exist on the opportunity costs of re-creation, and will be required to be estimated on a case-by-case basis.
Restore and re-create the area as necessary to enhance the	**Screened in**- The target can be directly based on existing status	The target could be very effective if implemented with adequate

[6] Eftec et al., (2017) Technical support in relation to the promotion of ecosystem restoration in the context of the EU biodiversity strategy to 2020.

conservation status of species listed in Annex II, IV and V of the Habitats Directive as well as wild birds associated with rivers, lakes, and alluvial habitats in view of achieving their favourable conservation status by 2050, with at least 15 % achieved by 2030 and at least 40 % by 2040.	reporting under the Nature Directives and is complementary to other targets.	resources to follow-up on all individual species. In addition, the target would allow habitats of a wider range to be considered for restoration action, for example habitats considered under EUNIS but currently not under Annex I of the HD. However, it would need to assess progress based on a much bigger body of data, as there are many more listed species than habitats and their restoration needs are more diverging.
Develop an inventory of all barriers in the EU and a plan of which ones to remove by 2030 with a view to achieving free-flowing status where possible and necessary to restore the habitats depending on the natural functioning of a river system.	**Screened in**- The target would assist in building the knowledge base on the extent of freshwater barriers to longitudinal and lateral connectivity present in the EU. With hydromorphological barriers noted as a key hindrance to the implementation of the WFD and Nature Directives, this target establishes a clear pathway to the eventual removal of barriers which have been identified as removable by MS.	A lack of EU-wide data on freshwater barriers exists, yet numerous MS and research-related (such as the AMBER project) databases are present- therefore there is a clear need to combine and upscale this information. This requirement would align with reporting currently required under the WFD, meaning additional costs for inventorisation could be considered small. A body of work and actions on barrier removal have been undertaken, meaning technical expertise on removal is available, and could be deployed to initiate important restoration efforts to re-establish the natural connectivity of rivers, in line with the targets of the 2030 Biodiversity Strategy. Studies on the related parameter of length of free-flowing rivers have also been initially carried out, however, currently there is not enough information to set a specific target in terms of km to be restored or number of barriers to be removed. For this further data collection and analysis would be needed.
Mapping out of small water units, with a view to identify their restoration and recreation potential and asses their contribution to improve connectivity between habitats as part of high diversity landscape features, contributing to the restoration of habitats and species.	**Screened in –** The target would assist in building the knowledge base on the extent of small freshwater units currently not explicitly delineated or grouped the Water Framework Directive and potentially playing a key role in maintaining biodiversity and connectivity between habitats. This target establishes a clear pathway to the eventual restoration of smaller bodies of water that may be key to	This target would build upon existing legislation and complement the other proposed targets. Smaller water units are not necessarily explicitly delineated or grouped together with delineated water bodies for the purpose of the characterisation of water bodies under the WFD. This is because the WFD, whilst setting clear quality objectives for all waters in Europe, relies on the concept of delineated 'water bodies' to make the

	the survival of important habitats and species.	compliance checking of the quality objectives under the Directive operational. Water bodies are delineated or grouped together with other water bodies based on the methodologies set out in Annex II, which may result in smaller water units not being delineated as actual water bodies under the WFD, making it more difficult also to assess compliance with the objectives which apply to all inland surface waters, transitional waters, coastal waters and groundwater. Some of these smaller water units may host habitats and species addressed by the Nature Directives and be partly addressed by targets 1a, 1b and 1c. They may play an important role as part of a diverse landscape and can contribute to habitat connectivity. They may also have significant potential in providing valuable ecosystem services such as water purification, carbon sequestration, water retention. Considering the flexibility under the WFD for Member State authorities to delineate their water bodies and whilst the latter are the units for assessing compliance with the objectives of the directive which however apply to **all** waters in the EU, it could be useful to also collect better information on the water units not part of delineated water bodies, to verify how severely they have been impacted, the primary pressures and the current conditions they are in, to be able to set a specific quantified target for restoration. For this reason mapping such small water units may play a role in helping to meet EU policy objectives on water quality and biodiversity, and in closing existing data gaps of unknown and unmapped habitats and conditions.
Implement standardised ecological flow assessments	**Screened out –** due to significant overlaps with the WFD. The target would require a conceptual definition of ecological flow with reference to flow quantity and dynamics in line with the WFD	The WFD already requires ensuring hydrological conditions that are compatible with the achievement of good ecological status. The CIS guidance n°31 provided clarification regarding this requirement by

	objectives to be set in national frameworks. The aim of the target is to explicitly require the setting and use of environmental flow assessments in Member States and integrate these within their WFD national frameworks by a specified date, not only for the assessment of water status but also in strategic planning and development. In this regard, the target would still be allowing for variations in Member States legislation and methodological approaches to ecological flow	defining ecological flow as an objective to be set in river water bodies. Setting a new legal target for ecological flow objectives would consequently be redundant with the requirements of the WFD and possibly jeopardize it by setting a conflicting deadline, considering that the objective to achieve good ecological status under the WFD (including good hydromorphological status and thus appropriate ecological flow) applies since 2015, with a limited possibility for time exemptions until 2027. One alternative option which would go beyond the strict requirements under the WFD would be to define, in EU legislation, the specific objectives of ecological flow for the different water bodies, as opposed to the current obligation resulting from the WFD for Member states to do so. However, this option was screened out as well as the nature of ecological flow requires specific assessment to be made at the scale of the river basin or water body and may change in time due to natural events or changes in the hydrology so would require regular updates and specific knowledge which the EU legislator does not have and could impossibly gather for all water bodies in the EU. Therefore setting such objective at EU level would not be appropriate. The data gaps regarding trends of flow changes and baseline assessments for ecological flow are too significant to allow for a realistic assessment of costs and benefits to be made.

As can be seen in the table above, five options have been retained for further analysis. To guide the reader through the remaining sections of this report, they have been named as follows:

Target 1a: Restore all HD Annex I freshwater habitats to good condition, with all necessary restoration measures completed on 30 % (or 15 %) of degraded areas by 2030, 60 % (or 40 %) by 2040 and 100 % by 2050;

Target 1b: Re-create area as necessary to achieve Favourable Conservation Status of rivers, lakes, and alluvial habitats of Annex I of the Habitats Directive at national biogeographical level by 2050, with 15 % (30%) achieved by 2030 and 40 % (60%) by 2040;

Target 1c: Restore and re-create the area necessary to enhance the conservation status of species listed in Annex II, IV and V of the Habitats Directive as well as wild birds associated with rivers, lakes, and alluvial habitats in view of achieving their favourable conservation status by 2050, with at least 15 % achieved by 2030 and at least 40 % by 2040.

Target 1d: Develop an inventory of all barriers in the EU and a plan of which ones to remove by 2030 with a view to achieving free-flowing status where possible and necessary to restore the habitats depending on the natural functioning of a river system.

Target 1e: By 2030, mapping small water units, determining their restoration potential and develop a plan to restore them where possible and necessary to contribute to the restoration of habitats and species.

6.4 Impacts of assessed target options

The costs of restoration of freshwater ecosystems were estimated by calculating the extent of degraded ecosystems to be restored annually to meet each target and applying average unit costs. Unit cost data for river and lake restoration projects were taken from a report detailing 766 restoration projects in the EU[7], with data for restoration of bankside habitats taken from Tucker et al (2013).[8] The costs include capital costs of restoration measures (channel re-shaping and re-meandering, deconstruction of technical riverbanks, reconnection of floodplain habitats, sediment control through reforestation, floodplain restoration), as well as costs of restoration, re-creation and maintenance of bankside habitats (forests and grasslands). The latter include opportunity costs of agricultural income forgone (e.g. through conversion of cropland and reductions in grazing) as well as the cost of work undertaken.

The benefits assessment included an extensive review of literature of the value of benefits of freshwater ecosystem restoration, which identified more than 30 relevant studies. The analysis applied estimates of the total ecosystem service benefits of river and lake restoration, taken from a meta-analysis by de Groot et al (2020)[9], as well as values for bankside ecosystems taken from the analyses for grassland and forest ecosystems. Per hectare benefits estimates were applied to the area of ecosystem restored to give annual estimates of total benefits. Annual costs and benefits were estimated over the period 2022 -2070, recognising that, while restoration takes place to 2050, further maintenance costs continue beyond that date, while restored ecosystems continue to provide benefits into the future. Annual cost and benefit estimates were discounted, applying a 4% social discount rate, and summed to calculate their total present value. This enabled total net present value (benefits – costs) and benefit: cost ratios to be calculated.

[7] Ayres et al. (2014). Inventory of river restoration measures: effects, costs and benefits. REFORM – Restoring rivers for effective catchment management. Deliverable D1.4 – Inventory of restoration costs and benefits

[8] Tucker et al., (2013) Estimation of the financing needs to implement Target 2 of the EU Biodiversity Strategy. Report to the European Commission. Institute for European Environmental Policy, London. Available at: https://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/Fin%20Target%202.pdf

[9] De Groot et al., (2020) Update of global ecosystem service valuation database (ESVD).

Targets 1a and 1b.

As a first step, the scale of restoration needs across the various freshwater habitats were calculated, based on a 15 % restoration target applied to the extent of those habitats currently not in 'good' condition (15 % min), and an estimation on the coverage of habitats currently in an 'unknown' status (15 % max). In addition, comparing Member States' data on 'favourable reference areas' with the actual habitat area allows to estimate how much area of the habitat would need to be re-created to achieve a good distribution and area of that habitat. A summary of these estimations is set out in Table VI-2 below.

Table VI-2 Calculated freshwater habitat restoration area and recreation area needs, based on a 15 % restoration target

Habitat type	Habitat area	Condition (km2)			Target		Restoration areas (km2) (average)	Recreation areas (km2)
	Total	Good	Not good	Unknown	15 % min (km2)	15 % max (km2)		
Lakes	59 121	36 760	9 953	12 408	1 493	3 354	2 424	282
Rivers	8 191	3 158	1 564	3 469	235	755	495	
Alluvial forests	23 421	10 932	8 677	3 812	1 302	1 873	1 587	27
Alluvial meadows	5 747	2 121	1 362	2 263	204	544	374	585
Total	96 480	52 971	21 556	21 952	3 233	6 526	4 880	894

The costs of restoration activities to meet the above needs were then estimated through literature, resulting in the costs detailed in Table VI-3 for a set of broad actions relevant to rivers and lakes. Each of these actions were weighted equally (i.e. each multiplied by 0.2), and their CAPEX values (capital expenditure) estimated through multiplying the costs of each weighted restoration action by the restoration area required from the table above (Table VI-2).

Table VI-3 Estimated costs of restoration relevant to Freshwater targets 1a and 1b (rivers and lakes)

Restoration action	Capital cost of restoration action per km^2 (EUR)
Channel re-shaping and re-meandering*	10 630 214
Deconstruction of technical riverbanks*	2 657 553
Reconnection of floodplain habitats	159 453
Sediment control through reforestation	192 589
Floodplain restoration	2 406 995

* Applied to rivers only as not directly relevant to lake restoration

Re-creation costs for alluvial forests and meadows (which are assumed to be the only habitats where re-creation will take place) in Table VI-4 were drawn from cost data under the Forests and Grasslands fiches (due to the overlap in habitat types), while OPEX values (operating expenditure) were obtained through literature at a broad ecosystem level.

Table VI-4 Estimated costs of restoration, recreation and maintenance, alluvial ecosystems

Habitat type	Maintenance (EUR/km2)	Restoration (EUR/km2)	Re-creation (EUR/km2)
Alluvial forests	23 200	403 100	35 000
Alluvial meadows	11 600	430 000	430 000

Next, the estimated annual area of restoration and recreation needed per habitat type to align with the specified restoration target was assessed, and the habitat type cumulative costs estimated over the trajectory of the target length (for example – to 2030, 2040, 2050) to derive a net present value (NPV) (2022-2050) estimate.

In relation to benefits, an assumption was made that degraded freshwater ecosystems produce only 50 % of the value in de Groot et al., 2020, which estimated that freshwater ecosystems provide ecosystem service values of €96,638/ha/yr (that is, the marginal benefit of intervention is worth (€48,319/ha). This figure includes a range of provisioning (fresh water, fisheries, genetic resources), regulating (waste treatment, water quality, flood management, climate, soil quality) and cultural (landscape, aesthetic, inspirational and recreational) services.

A summary of this is presented in Table VI-5 presenting the option of incrementing the percentage of restoration from 15 % to 40 % with a larger effort in the last decade to achieve a 90 % restoration target, and Table VI-6 presenting an option for a more linear increment of effort 30 % 60 % and 90 %.

Target 1c

Data from reporting of Article 12 of the Birds Directive and 17 of the Habitats Directive show that the major pressures for birds are related to agriculture and conversion of land, while hydropower dams and physical alternations to water bodies (e.g. hydromorphological changes) present the greatest pressures on fish. Hence the target should be seen as a sub-target that assist in the implementation and achievement of target 1a, while also extending habitat restoration to those not covered in Annex I of the HD. Furthermore, implementation of barrier removal (target 1d) will have direct benefits towards species, especially migratory fish. However, calculating precise costs of enhancing the status of species will be case-specific, given the complexity of species interactions per habitat type, and dependent upon the biophysical conditions within the restoration/re-creation area. As such, costs estimates related to Target 1c are assumed to similar to those established under Targets 1a, 1b and 1d.

Target 1d

For target 1d an estimate of €385 183 was estimated for the costs of creating an EU-wide inventory of barriers, based on data from the AMBER project. The lack of data available on barrier removal costs, and the context-specific nature of these removals has not allowed a full cost-benefit analysis to be developed (and the costs of barrier removal are therefore not included in the tables below - only the costs of the inventory). However, Table VI-6 provides an overview of costs for different type of barrier removal, demonstrating the variability of such costs. The benefits derived from barrier removal could be expected to be like the benefit estimates for Target 1a and 1b (i.e. barrier removal would be required to achieve the benefits outlined under 1a and 1b), however studies which explicitly ascertain the benefit values derived from such actions could not be identified. Other costs linked to a barrier mapping exercise are expected to be minimal compared to the actual removal measures, also because the exercise could draw upon data already available to Member States. The current data gaps as regards not only costs of removal, but also location and characteristics of different barriers, do not allow at present setting specific target on length of free-flowing rivers or number of barriers to be removed, but would need to be investigated further as more data becomes available.

The tables VI-5 and VI-6 estimate the costs and benefits of Targets 1a, 1b, 1d (inventory only), for the various ambition levels, up to 2030, 2040, 2050 and 2070 and Table VI-7 provides an overview of costs for different type of barrier removal.

Table VI-5: Summary of present value cost-benefit analysis results (MEUR) of achieving restoration targets for Target 1a, 1b, and 1d 15 % 40 % and 90 %[10] target, 4 % real discount rate

Period	% Full restoration	Costs (MEuro)	Benefits (MEuro)	NPV	Benefit-cost ratio
2022-2030	15%	9 655*	58 628	48 973	6
2031-2040	40%	10 670	158 968	148 298	15
2041-2050	90%	13 757	253 218	239 461	18
Total over period (to 2050)					
2022-2050	90%	34 082	470 814	436 732	14
Total over period to (2070- to include projected continuation of benefits and costs)					
2022-2070	90%	35 232	862 349	827 117	24

* Costs include inventory

[10] Although the 2050 target aims to restore 100 % of the habitat, the 2050 cost estimation is for 90 % restoration as this is the maximum percentage that can be expected in practice. Furthermore, an extrapolation of current restoration costs would no longer provide reliable estimates in the range between 90 and 100 %.

Table VI-6: Summary of present value cost-benefit analysis results (MEUR) of achieving restoration targets for Target 1a, 1b and 1d 30 % 60 % and 90 % target, 4 % real discount rate

Period	% Full restoration	Costs (million Euro, annual)	Benefits (Euro)	NPV	Benefit-cost ratio
2022-2030	30%	17 891*	116 695	98 804	7
2031-2040	60%	12 554	257 788	245 235	12
2041-2050	90%	8 616	288 989	280 282	34
Total over period (to 2050)					
2022-2050	90%	39 061	663 382	624 321	16
Total over period to (2070- to include projected continuation of benefits and costs)					
2022-2070	90%	40 211	1 053 042	1 012 831	26

* Costs include inventory

Table VI-7 Costs of barrier removal

Barrier removal action	Metric	Average cost (EUR/m^3)
Dike removal/modification	€/m^3 dike volume	31
Longitudinal connectivity through migration passes for fauna	€/m obstacle height	96 584
Longitudinal connectivity through Weir removal	€/m weir height	30 518
Longitudinal connectivity through dam removal*	€/m^3 of concrete	34

It can be expected that most costs will be incurred by the governmental agencies who ultimately decide where restoration actions/barrier removals will take place. Compensation will likely be needed for economic actors impacted by the restoration efforts. For example, energy providers who rely on cooling water may require additional flood defences following barrier removal, land managers on alluvial habitats may require compensation for crop damage following barrier removal or compensation for alternative management practices to restore degraded habitats. Compensation costs may also be required in the event of the redistribution of pollutants following the removal of barriers. Restoration actions are likely to benefit a range of stakeholders, namely:

- The local population- through changes in house prices due to improved/ decreased flood risk potential.
- Water suppliers and consumers- through overall reduced water pollution and enhanced availability.
- Recreational users of freshwater ecosystems- through greater access to previously restricted areas (due to barrier removal), enhanced aesthetic values and biodiversity of the ecosystem.

- Organisations/businesses- through their direct involvement in restoration actions (employment and knowledge) or through the enhanced recreational services provided by restoration actions.
- Society- through the enhancement of ecosystem services.

Target 1e

This target aims to include and delineate smaller water units with high restoration potential, increase their protection and build more coherent and functional freshwater habitat connectivity. Restoration potential can be estimated using existing assessment tools under the BHD and WFD, as well as European Red List species and habitats. The target would require a mapping *out and inventorising of small water units by 2030.* With the information collected and reported by Member States, a solid baseline assessment of the situation of EU small water units could be conducted. The baseline would enable the Commission to move forward with setting well-informed and reasonable restoration targets for small water units of the EU, with the aim for Member States to then implement restoration actions after 2030.

The mapping exercise will likely draw on upon data that Member States already have at a national level and partly build on known methodologies under WFD, as well as on data from Copernicus. Preliminary investigation into Copernicus data from 2016 identified 4 176 surface lake water units that are smaller than 0.5 km^2 (this does not include small rivers). The total surface area of these cover 822 km^2. This data does not provide information on wetlands, floodplains, riparian zones or other ecosystem that may have vegetation and could likely fall into the categories of smaller units of water. Neither is there information on how many of these water units are already integrated into the WFD as part of the water bodies covered by RBMPs. As such, Copernicus data can assist in preliminary mapping of existing small water units, but with limitations. Member States would have to further expand on existing data. Nonetheless, the use of existing data from Member States, the WFD and Copernicus could help reduce additional cost burden on Member States.

Costs for mapping and assessing smaller water units are mainly administrative. The cost on enabling measures such as establishing extent and condition of areas and ecosystems have, among others, been assessed in section 6.5 of the report.

The assessment of the restoration potential is likely to have a higher cost and will partly depend on information acquired during the mapping exercise. The key restoration measures for larger water bodies and their estimated costs listed in Table VI-3 will be similar to those required to restore smaller water units. In addition, small water units can also be restored by restoring connectivity – estimates of barrier removal costs have been given in Table VI-7. The exact type of action which would be required to assist in the restoration of the smaller water units would depend on their condition and can only be estimated once an inventory and strong baseline exist. Such exercise could be useful since the information collected would help make informed decisions on other targets and help achieve additional policy objectives.

6.5 Synthesis

Of the options considered, Target 1a is considered as the most effective and efficient way to return European freshwaters to good status. Target 1b is seen as a complementary measure to achieving Target 1a, and as such they could be merged as one target to achieve both restoration and re-creation. Target 1c overlaps with target 1a, 1b, 1d and 1e and is in principle unlimited in terms of freshwater area covered. This means that its potential in terms of area covered may be the highest across options. The effectiveness of this option may however depend on the specific actions taken to improve condition of species and their effect on overall ecosystem health, both in- and outside of the Annex 1. Target 1d is estimated to provide a range of benefits like those deriving from Target 1a and b, whilst also directly relieving EU waters from the frequent hydromorphological pressures reported and addressing an important data gap in terms of type and location of barriers. As for target 1e, it sets the possibility of closing a data gap regarding smaller water bodies of ecological importance. This would directly link to target 1a, 1d as the restoration of smaller water units is important for ecosystem connectivity, especially lateral. All options are foreseen as being feasible, and align with the reporting and monitoring requirements currently in place, particularly through the WFD and Nature Directives. The benefits deriving from all options are generally considered to outweigh the costs, although this is less clear-cut for target 1d, given the significant variation in the costs of barrier removal and the benefits stemming from this, due to the significantly contrasting scale and differences in biophysical conditions in each context, and target 1e, considering the potentially large variations of costs in collecting such data.

Table VI-8: Overview table assessing options on EU impact assessment criteria

	Target 1a- Restore degraded freshwater habitats under HD Annex I	Target 1b- Re-create area as necessary to achieve Favourable Conservation Status of HD Annex I	1c: Restore and re-create the area as necessary to enhance the conservation status of species	Target 1d- Develop an inventory of all barriers in the EU and remove prioritized barriers	Target 1e – Mapping of small water units
Feasibility / effectiveness	High feasibility and potential for restoration. The effective restoration of freshwater habitats has been shown to provide a range of ecosystem services.	Feasibility dependent on opportunity costs of re-creation. Re-creation is intrinsically linked to restoration in freshwater habitats, and is estimated at being highly effective for biodiversity, and contributes to other ecosystem services.	High feasibility and potential for restoration, with this Target linking strongly to the other targets and assisting in the overall target of restoration (1a)	The inventorisation should be feasible as indicated through the AMBER project. The removal of barriers, once identified is considered as an effective way to restore freshwater ecosystems.	The mapping should be feasible as data is already available through WFD, Nature Directives and Copernicus data, and can be complemented by additional data from Member States. Target links strongly, but partially overlaps, to target 1a, 1c and 1d. Protection and restoration of small water units could be an effective way to

					achieve the other targets and considers additional waters which may otherwise be excluded under target 1a.
Efficiency	Strong evidence of benefits of restoration for biodiversity and ecosystem services, including climate mitigation. Available valuation evidence suggests benefits exceed restoration costs.	Due to the interlinkages with the aforementioned target, it is estimated that re-creation derives similar benefits.	Strong evidence of benefits of restoration for biodiversity and ecosystem services, including species protection and recovery of populations.	Costs of removing barriers can vary considerably, yet the inventory process will allow the identification of barriers which could, for example, be removed for the lowest cost. Furthermore, the lack of associated maintenance costs can further increase benefit: costs ratios.	Some evidence of benefits, for biodiversity restoration and the achievement of the other targets. Costs of enabling measures, linked to surveying and establishing extent and condition of smaller water units can vary considerably, although data collection would rely on existing data sources and the reporting/monitoring would fall under the National Restoration Plans.
Coherence	Full coherence with EU environmental policies and climate goals. Potential to make substantial contributions to EU nature and water policy	Full coherence with EU environmental policies and climate goals. Potential to make substantial contributions to EU nature and water policy	Full coherence with EU environmental policies as this option builds on existing legislation (i.e. the HD). Benefits for other EU objectives such as on water- and flood risk management are also expected.	Full coherence with EU environmental policies and climate goals. Potential to make substantial contributions in particular to EU nature and water policy.	Coherence with EU environmental policies and climate goals. Potential to make contributions in particular to EU nature and water policy
Proportionality	Proportionate to the very high importance of the habitats for	Proportionate to the high importance of the habitats for	Proportionate to the high importance of	Proportionate to the high importance of the habitats for	Difficult to assess proportionality. While such small water units may be

	biodiversity and associated ecosystem services	biodiversity and associated ecosystem services	the habitats for biodiversity.	biodiversity and associated ecosystem services	important for biodiversity and associate ecosystems, the extent of the overlap with other targets and existing legislation is not known and it is difficult to estimate costs. This hinders the assessment.
Conclusion	**Include with high priority**	**Include with high priority**	**Include with high priority**	**Include with high priority**	**Consider further, as a possible second stage target**

7. Marine ecosystems

7.1 Scope

There is a wide consensus at the international level that restoration efforts are as relevant to marine ecosystems as they are to the terrestrial environment. Academic research and on-site trials show that focusing on restoring habitats can be a particularly effective way to achieve the recovery of whole marine ecosystems, including species (see section 7.4). Habitats not only host individual species but are maintained through complex biological, physical and chemical interactions. They can also act as an effective surrogate for species conservation and the delivery of ecosystem services alongside species-specific conservation measures, such as those targeting the recovery of ‘keystone species’ or of ‘ecosystem engineers’.

Science shows that restoring marine habitats (where species live, reproduce and forage) both sets the enabling conditions for species and ecosystems to thrive and allows delivering enhanced ecosystem and societal services to the benefit of multiple blue economy sectors (e.g. fisheries, tourism etc.). Restoring particular habitats, such as seagrass beds, can also help mitigate climate change by storing carbon and help society adapt to climate change by buffering storms and reducing the impact of sea level rise and coastal erosion.

Considering the above, the principal scope of the marine thematic impact assessment concerns a restoration target related to groups of habitats that were selected because they have the capacity to contribute substantially to the restoration objectives under the Biodiversity strategy, in particular towards mitigating climate change, reducing the impact of natural disasters and bringing health, social and economic benefits to coastal communities and the EU as a whole. These habitats can also substantially contribute to delivering other key ecosystem services that benefit society. Some of these ecosystem services would be delivered over a longer time horizon (2050 and beyond) because of the inherent slow changes in some marine ecosystems. However, restoration efforts should be initiated now to ensure the future delivery of these ecosystem services to society, future generations, and the planet.

Focus is therefore given to these **habitat groups:**

- **Seagrass beds**
- **Macroalgal forests**
- **Shellfish beds**
- **Maerl beds**
- **Sponge, coral and coralligenous beds**
- **Vents and seeps**
- **Soft sediments**

Many natural habitat types that can be considered under these habitat groups correspond to those listed in Annex I of the Habitats Directive (HD), to the habitats of species protected by HD and the Birds Directive (BD) and to the broad habitat types listed in the Marine Strategy Framework Directive (MSFD). However, considering that different habitat types under these broad categories can have different restoration requirements and potential, as well as different contribution to the above-identified objectives of the Biodiversity strategy, it is necessary to further select and define the list of habitats that should be considered for marine restoration. This could be done by using the appropriate levels of the European nature information system (EUNIS) classification of marine habitats, which would provide a common understanding of selected habitats across all Member States.

The selected marine habitat groups are variously distributed from the coastline to depths of 5000m or more. However, the feasibility of restoration and effective tracking of results achieved by implementation of restoration measures decreases with depth. Assessing the condition of habitats in waters deeper than 1000m can be very costly, in particular for the vast area of sediment habitats below 1000m that make up about 80% of the total area of EU seabed. At the same time, anthropogenic pressures acting at those depths, such as illegal fishing (as regulated fishing is prohibited below 1000m depth), litter and energy/telecom transmission infrastructure, are expected to be very limited in spatial extent compared to the overall extent of sediment habitats below 1000m depth. Therefore, it would be appropriate to limit the application of restoration measures for sediment habitats to above 1000m depth, in order to better focus the efforts and resources.

The selected marine habitats of Annex I of the Habitats Directive cover 240 030 km^2 or 4.8 % of the EU seas[11]. More detailed quantitative data on the geographical distribution, area (km^2), conservation status and condition of marine habitat types of Annex I of the Habitats Directive, ts derived from the Member States' reports and assessments under Article 17 of the Habitats Directive in EU Member States is provided in Annex VIII-g.

7.2 Problem, current trends and ecosystem-specific baseline

Human impacts are radically reshaping the marine environment, including in the EU, and the scale of the challenges to restore marine ecosystems to good status should not be underestimated. Many scientific studies conclude that the oceans' carrying capacity is being degraded and there is an overriding need for urgent action, in particular to halt and reverse the decline of marine biodiversity. The effects of climate change combined with the loss of marine biodiversity (through human-induced pressures) also endanger economic prosperity worldwide. Fishing (overfishing, impact on the seabed, on juveniles and on sensitive marine species), aquaculture, pollution, eutrophication, seabed mining, invasive alien species, coastal and offshore developments are all contributing to loss and damage of marine habitats and the irreplaceable ecosystem services they supply to humanity.

A review conducted between 2011 and 2016 on the pressures on the marine realm resulting from human activities on land or at sea concluded that practically the entire EU marine area was under multiple pressures, including from hazardous substances, climate change, underwater noise, non-indigenous species, marine litter and nutrient enrichment. Fishing pressure and seafloor damage are high in the seabed shelf area, whilst impacts of invasive alien species and physical disturbance are high in coastal areas. The highest combined effects are found along coastal areas of the North

[11] Romania is not included due to data issues.

Sea, Southern Baltic Sea, Adriatic and Western Mediterranean. The most extensive combined effects in the shelf areas occur in the North Sea and in parts of the Baltic Sea and Adriatic Sea.
The success of restoration actions will depend on many factors, including current status, magnitude of human pressures, sensitivity of habitats to these pressures, knowledge and experience of what actions to take and timescales over which actions can be applied. Habitat restoration can be achieved through active measures (e.g. replanting seagrass) and/or passive measures (leaving habitats undisturbed, often through protected areas, so that habitats recover naturally). These two restoration approaches bear different constraints and costs (as discussed in section 7.4). Whatever the restoration method, the measures should be set to ensure the restored habitats do not degrade again.

A high proportion of marine habitats protected under the Habitats Directive are in unfavourable conservation status or declining and the pressures affecting them are increasing. Under the Marine Strategy Framework Directive, all EU marine waters should have reached a Good Environmental Status in 2020. Under current knowledge and latest assessments, there are indications that this goal has not been fully reached, including for marine habitats.
The following summarises the findings from the baseline scenarios for the European marine environment. Due to lack of data on individual categories, marine ecosystems were grouped together for the region:

- ***Ecological condition:*** Reporting under the HD shows that most Annex I marine habitats are in an unknown condition. Of those with a known condition, the areas in good and non-good condition are roughly equal. Trends for areas in not-good condition is largely either unknown (48 % of reports) or stable or deteriorating further (47 %).
- ***Chemical status:*** Under the WFD, the chemical status indicator includes the status of land and coastal waters as reported in the 1st and 2nd River Basin Management Plans and describes a water body as either "failing to achieve good", "good", or "unknown". Even though the data between the 2 reports are not comparable due to many changes, deductions can be made (Maes et al., 2020b). According to the 2nd Plan in 2016, there had been substantial improvement in the chemical status of the Black and Mediterranean Seas compared to 2010. The number of bodies with an "unknown" chemical status declined considerably from 2010 to 2016. Most areas "unknown" in the 1st Plan are classified as "good" in the 2nd.
- ***Nutrient Concentration***: Long-term declines in nutrient concentrations have been observed in the North-East Atlantic and the Baltic Sea. An increase in nutrient load is causing noticeable deterioration of ecosystem conditions in southern EU. Long- and short-term trends highlight that nitrates and phosphates concentrations are rising in the Black and Mediterranean Seas. 98 % of the Baltic Sea is classed as problem areas in either moderate, poor or bad state. Only 0.2 % of the Mediterranean was assessed but 42 % of this area is classed as a problem area. In the Black Sea, 59 % of the sea area was assessed and 31 % is classed as problem area. In the Northeast Atlantic, 25 % was assessed and 94 % is in a good or high status.
- ***Chlorophyll-a***: Overall, eutrophication and land runoff have caused increased Chlorophyll-a concentrations. While such increases can be observed in the long-term trends for the

Black Sea, Baltic Sea, and Mediterranean Sea, concentrations in the North-East Atlantic remain unchanged.

- ***Oxygen***: From 1993 to 2018 the Baltic and Black Seas have seen significant improvement with trends of increasing dissolved oxygen. The Mediterranean has seen long-term improvement but short-term degradation. The North-East Atlantic has exhibited declining trends.
- ***Litter***: Long-term trends in beach and seafloor litter could be assessed in the North-East Atlantic only. The trend in seafloor litter was unresolved, and that for beach litter was decreasing, suggesting an increase in coastal environmental quality. Data on micro litter are insufficient for evaluating short- and long-term trends.
- ***Ecological status***: Overall, marine water bodies with high ecological status (according to the WFD) decreased in 2016 compared to 2010, especially in the Mediterranean. A considerable decrease in the 'unknown' class has been recorded, possibly because of advances in assessment methods. Biodiversity quality elements reported as 'good' have increased substantially for all regions; except for the Back Sea where data is missing.
- ***Spawning stock biomass (commercially exploited fish and shellfish)***: If historic trends continue, it should increase in all regional seas by 2030 and 2050. However, it is important to note substantial uncertainty around these projections. Central estimates suggest that by 2030 indicator values could be 14 % higher than the value in 2017 for the North-East Atlantic, 16 % higher in the Black Sea, 53 % higher in the Baltic Sea and 102 % higher in the Mediterranean. Uncertainty estimates suggest biomass could decline in the future in the Baltic Sea, Black Sea and Northeast Atlantic.
- ***Invasive alien species***: Data concerning invasive alien species, their abundance and impact is incomplete and inconsistent, so short- and long-term trends cannot be calculated.

Whilst the EU biodiversity strategy for 2020 had set voluntary restoration targets, the evaluation of this strategy showed that this instrument proved ineffective in delivering the set objectives. Of the thousands of MSFD measures reported by Member States, only 35 mention explicitly restoration. Whilst passive restoration should already be happening through existing legislation, mainly through marine protected areas, less than 1% of MPAs is strictly protected, which should ensure that natural processes are left undisturbed by human activities.

A challenge in implementing existing legislation to restore degraded marine areas is that the habitats in the existing directives (HD and MSFD) are defined too broadly and comprise many ecologically different sub-types with different restoration potential, which poses a challenge for defining and prioritising restoration measures. For example, the habitat type "1170 Reefs" protected under the HD includes both shallow macroalgal communities and deep-water coral reefs, which, in the context of restoration, require very different measures. Prioritising a limited list of habitats defined at a more detailed level (or rather: habitats-structuring/habitat-forming species, such as *Posidonia* beds, kelp, etc.) would both:

- help address both the salient elements listed under the Biodiversity Strategy for 2030 (climate change mitigation, reduction of natural disasters, nursery areas/protection of juveniles)
- help improve the status of key marine habitats, thereby helping address the objectives under the HD/BD and the MSFD.

Other reasons for limited progress under the current legislation include insufficient knowledge about the condition of some habitats over their entire area of distribution, about detailed management measures needed to support the restoration for some habitat types, the complexities of addressing cumulative and in-combination pressures and effects and the need for coordinated and collective action in some cases which may be required across sectors, as well as across governance arrangements and Member States. The timescales over which positive trends become apparent for some marine habitats and species are also relevant. In extreme cases, recovery may require decades or centuries, and signs of improvement may show only long after the necessary management measures have been introduced.

Recent policy initiatives and actions which could help progress restoration include:

- The EU Biodiversity Strategy target to expand the EU MPA network to cover 30% of EU seas, with 10% of EU seas under strict protection. The Strategy should also contribute to reducing marine pollution and eutrophication in the next decade through its 2030 objective to reduce use of chemical pesticides and high-risk pesticides by 50%; and of fertilisers by 20%.
- The action plan to conserve fisheries resources and protect marine ecosystems, announced in the Biodiversity Strategy
- The 2020 Farm-to-fork strategy sets out by 2030 to reduce the use of fertilisers by 20%, reduce nutrient losses by 50%.
- The upcoming 2021 EU Soil Thematic Strategy aims to reduce the overuse of nutrients.
- The zero pollution Action plan sets 2030 targets to reduce pollution at source, some directly impacting ocean, like improving water quality by reducing plastic litter at sea by 50% and microplastics release into the environment by 30%, significantly reducing waste generation and by 50% residual municipal waste. The measures adopted in the framework of the 2018 EU Plastics Strategy will likely also have an impact on reducing plastic in marine ecosystems.
- The 2018 recast of the Renewable Energy Directive sets a new 2030 renewable energy target of at least 32%. In 2020, the EC also issued a strategy to harness the potential of offshore renewable energy. This industry will need to scale up 5 times by 2030 and 25 times by 2050 to support the Green Deal's objectives. Maritime spatial planning will be essential to avoid conflicts with other activities and limit impacts on marine ecosystems.
- The EU climate and energy package should contribute to global mitigation of climate change. However, the impacts of these actions are unlikely to have a significant effect on marine ecosystems before 2050.

In conclusion, the state of the European seas is poor and biodiversity loss has not been halted. Faced with the increased threats posed by overexploitation of marine resources, pollution and climate change, urgent action is needed to bring them back to good condition through large-scale restoration of marine ecosystems.

How will the situation likely evolve?

- **In the Northeast Atlantic,** chemical and nutrient conditions appear likely to improve in the near term. Pressure from pollution is likely to diminish further because of forthcoming measures under the Biodiversity Strategy and the common agricultural policy. The ecological status reported under the WFD suggests improving conditions, which is consistent with projections of increasing spawning stock biomass, increasing coverage of protected areas and decreased pressure from fishing mortality.

- **In the Baltic Sea**, chemical conditions are currently poor, with much of the area categorised as problem area. However, trends point to improvement, and this is likely to be accelerated by current and proposed measures. Increases in spawning stock biomass and in protected areas coverage will help to contribute improvements. A continued reduction in fishing mortality pressure can be expected but mortality still exceeds maximum sustainable yields.
- **For the Black Sea**, marine ecosystem conditions are unlikely to improve. There has been significant degradation in nutrient conditions and chlorophyll concentrations, although dissolved oxygen concentrations have increased. The trends in spawning stock biomass is projected to lead to improvements but this is likely to be offset by high levels of fishing mortality, which have shown little change and remained more than double maximum sustainable yields in 2017.
- **The Mediterranean** is also unlikely to see improvements in ecological condition under a baseline scenario. It has seen declines in its nutrient status and in levels of dissolved oxygen. Spawning stock biomass has recently increased and could continue to increase, this is at odds with fishing mortality which has seen little change and was more than double the maximum sustainable yields in 2017.

7.3 Target options screened in/out

Considering the challenges identified, several approaches to setting marine restoration targets were considered and screened for adequacy. The selected approach was then impact assessed. The results of this screening are summarised in the table below.

Table VII-1: Screened approaches to setting restoration targets

Approach option	Screened in/out for assessment	Key reason(s) for screening in/out
Option 0 – The current policy and legislative framework is implemented without setting any specific marine restoration targets. This means that the restoration	Out	The lack of deadline to achieve the favourable conservation status of protected habitats and species under the Birds and Habitats Directives would continue to result in low

efforts would be driven by the requirements of the Birds, Habitats and Marine Strategy Framework Directives which relate to the broad habitat types and habitats of the species and by other actions identified in the Biodiversity Strategy for 2030.		ambition and extent of restoration measures, because of the lack of precise and time-bound restoration targets. In addition, the broad habitat types as defined under the directives would not result in the necessary focus of restoration action in accordance with the priorities in the Biodiversity strategy. Other targets and commitments in the Biodiversity Strategy could contribute to enhanced restoration, but with very uncertain or insufficient outcome for the marine environment. For example, the target on 30% improvement under the Strategy does not necessarily need to address marine habitats and species and 10% of strictly protected areas that may result in passive restoration may be insufficient and may not target all key areas or ecosystems. In addition, these targets are only voluntary commitments.
Option 1 - The marine strategy framework directive (MSFD) and its 2017 Decision on good environmental status contains very broad habitat types with their associated biological communities: 22 benthic/seabed and 4 pelagic/water column (Member States can select additional habitat types). Restoration efforts could focus on identifying degraded habitats and undertaking restoration efforts (passive and active) to restore them to Good Environmental Status. Under the Habitats Directive, marine habitat types listed in Annex I (also broad categories with many sub-types) should be maintained at or restored to their favourable conservation status. To ensure results are delivered, the targets could relate to a more detailed level of habitat classification than the existing directives, numerical/percentage restoration targets could be set and reached within certain deadlines.	**In**	According to international practice, the restoration of degraded habitats is the most feasible and will deliver the maximum number of multiple benefits to nature and society. Addressing the priorities identified in the Biodiversity Strategy (degraded ecosystems, in particular those with the most potential to capture and store carbon and to prevent and reduce the impact of natural disasters, and protect important fish spawning and nursery areas) is best done by restoration of habitats, in particular when priorities are set at the meaningful scale of habitat classification. Habitats have been shown to be an effective surrogate for species and the delivery of ecosystem services. Furthermore, in delivering this target, significant progress will be made against the other options.
Option 2 - The MSFD and the Decision on Good Environmental Status contain a number of broad	Out	The focus on species restoration by direct rebuilding of populations (rearing or reintroduction) would

species groups (of birds, mammals, reptiles, fish and cephalopods) as features for Good Environmental Status assessment. The Birds Directive protects all wild birds, including seabirds. The Habitats Directive strictly protects many marine species, including all cetaceans and sea turtles. The two directives also require designation and management of protected areas to contribute to reaching the favourable conservation status of habitats and species. Restoration efforts could focus on identifying and limiting key pressures impacting focal species and taking steps to rebuild the populations through targeted interventions.		not achieve the wide benefits of habitat restoration, which includes re-establishment of functional ecological processes necessary to support populations of species. However, restoration of habitats of species would contribute to species restoration and could be included in Option 1.
Option 3 - To restore habitats in order to maximise the delivery of key ecosystem services. This, the approach would not, in the first instance, aim to achieve good environmental status under the MSFD or favourable conservation status under the Habitats Directive. However, it is likely that restoring the habitat to deliver the intended ecosystem services would result in significantly improved habitat condition. Instead of focusing on a numerical / percentage area to restore, this option could be used in combination with option 1 to guide/advise where the restoration action should take place in order to maximise the delivery of (multiple) ecosystem services.	Out	The scientific knowledge and data available do not allow setting meaningful and scientifically sound targets about ecosystem services at this level.

7.4 Impacts of assessed approach

The proposed target for the marine environment that was impact assessed is:

– To put in place, for each of the above-mentioned habitat groups, the necessary restoration measures to improve all areas that are not in good condition to good condition, with measures put in place on at least 30% of the areas that are not in good condition by 2030, at least 60% by 2040 and 90% by 2050.
– To put in place, for each of the habitats classified in the above-mentioned habitat groups, the necessary restoration measures to re-establish them in areas not covered by these habitat types, with measures put in place on at least 30% of the areas needed to reach the favourable reference area, by 2030, 60% by 2040 and 100% by 2050.

- To put in place restoration measures for the habitats of marine species listed in Annexes II, IV and V of Directive 92/42/EEC and Annex I of Regulation 2019/1241, as well as of wild birds protected under Directive 2009/147/EC by 2050.

Implementation and enforcement

The proposed target takes into account the rationale of the approach selected, namely that the restoration effort should focus on habitats (these also host a variety of species) which are important to achieve the objectives of the Biodiversity Strategy. It proposes time-bound targets to achieve good condition of habitats, with intermediate targets for 2030, 2040 and 2050, which may be reached by incrementally establishing restoration measures. It includes both improvement of the condition of present areas covered by habitats and re-creation of habitats that were lost through human pressure on the marine ecosystem.

The habitat types and their condition vary between Member States. For example, *Posidonia* beds are only present in the Mediterranean Sea. Therefore, Member States will be able to select the habitats present in their territory from the list of habitats under each of the habitat categories. The targets for putting in place restoration measures concern each habitat of the habitat group concerned. This means that the Member States would have certain flexibility in prioritising the restoration of certain habitats, depending on their national situation. When presenting their nature restoration plans, Member States will need to justify why they chose to restore the habitats selected. The phased approach with incremental targets for 2030/40/50 enables a step-wise development and implementation of restoration measures with equal distribution of effort. This provides a very flexible but focused approach.

Considering that the condition of many marine habitats is generally not well known over their entire areas of distribution, it will be necessary to fill the knowledge gaps by putting in place additional surveillance for the targeted habitat types. Some Member States may have to put in place additional monitoring methodologies and programmes. This should be done as early as possible and at the latest in the phase of the preparation of the national restoration plans. Since the existing obligations under BHD and MSFD already require collection of this information, their implementation should also be improved to provide the necessary basis for the implementation of restoration measures.

Considering that many habitats listed in Annex I of HD correspond to the proposed habitat groups, the legal obligation to achieve favourable conservation status of Annex I habitat types would additionally benefit from a legally binding date for achievement of this target. Moreover, the implementation, enforcement and assessment of the progress towards the achievement of the target would partly rely on the same mechanisms (e.g. monitoring and reporting) as used under the BHD and the MSFD, and this would need to be supplemented, where necessary, with enhanced monitoring of the implementation of restoration measures and of the condition of habitats.

Key stakeholders

The key economic stakeholders to be involved in the restoration of marine habitats include those economic sectors whose engagement is crucial to reduce the pressures on the marine environment, including those involved in coastal (including land-based) operations that result in changes to hydrological conditions leading to sedimentation and altered water flow (e.g. agriculture); pollution (e.g. aquaculture) and the introduction of invasive species (e.g. shipping). In addition, stakeholders whose operations result in physical damage to habitats (e.g. mineral extraction, fishing) are key to the success of restorative actions, (Table VII-2).

Table VII-2: An indication of the key stakeholders (economic sectors) whose engagement is needed for the successful restoration of the selected habitats

Habitat groups	Stakeholders (economic sectors)						
	Fishing	Shipping	Mineral extraction	Agriculture	Energy	Aqua-culture	Tourism/ Leisure
Seagrass beds							
Macroalgal forests							
Shellfish beds							
Maerl beds							
Sponge, coral and coralligenous beds							
Vents and seeps							
Soft sediments							

Note: darker shades of blue indicate stronger engagement requirements. White shades indicate no engagement foreseen, grey indicates minimal engagement requirements.

Costs

The cost of restoration varies considerably depending on the focal habitat, its location and condition, the level of pressure, the scale and desired outcome and the method used. There are a few irreducible costs that relate to broad actions that will contribute to the conservation and restoration of marine ecosystems, irrespective of the habitat and restoration method:

- Development of national strategies, policies and legislation to support restoration measures;
- Administration of authorities and relevant environmental organisations;
- Enforcement of regulations (including protecting restored habitats through protected areas);
- Advice and training;
- Additional research and monitoring required to develop and improve restoration measures; and

- Communications, such as consultations, and awareness raising on nature conservation and restoration issues.

The major costs will consist in assessing and monitoring the condition of habitats, establishing and enforcing marine protected areas and other spatial protection measures (as required) and transaction costs for active restoration projects, such as project planning, project selection, contracting and project oversight and financial administration. Considerations should also be given to compensation for loss of income, for example for fisheries, or for opportunity cost. However, some of these costs can be offset by direct benefits to those affected, although this will vary depending on the specific restoration measure.

As administrative processes have already been developed for numerous nature conservation and restoration projects, no major changes are anticipated, and administrative costs are likely to be similar to recent restoration projects and as experienced in the implementation of the Natura 2000 network. Similarly, Member States have existing requirements under environmental legislation, such as the surveillance of the status of Annex I habitats under the HD and of habitats covered by the MSFD, or of certain ecosystem components under the Water Framework Directive, which should facilitate the implementation of the restoration target.

Some examples of restoration costs for different habitats are given in the table below.

Table VII-3: Estimates of financial restoration costs. Costs are given for active restoration unless stated

Habitats	Cost (active restoration per hectare unless otherwise stated)
Seagrass beds	64 data entries: Range €6,683 - €2,393,726 per hectare (median €107,241 per ha for developed countries). Total costs (including all operational and in-kind costs) likely 2-4 times higher. Transplantation of cores or plugs (€29.8K ha-1) is more cost-effective than mechanical transplantation (€1.2 million ha-1) (1)
	Passive restoration - €2,202 - €474,340 per hectare; median €238,271 (1)
Kelp & macroalgal forests	~€1 million per hectare (based on a 0.0 1hectare experiment; ~€4 million per hectare using artificial reefs (based on a 0.05-hectare experiment) (2)
	Passive restoration - removing sea urchins by liming, based on 90-hectare experiment): €1,433 per hectare
Shellfish, mussel & oyster beds	Oyster reef, (23 data entries): Range €3,796- €1,834,549; median €56,497 per hectare for developed countries (3)
	Noble pen shell translocation experiment: €8 per individual and assuming an aim of 100 -2000 individuals per hectare (based on densities at existing sites in the Mediterranean) gives a total of €800 – €16,000 per hectare (3)
Maerl bed	No information available; however similar habitat estimates below:
	Red coral - (based on two experiments 0.005 hectare): estimate likely €1.12 - 3.45 million per hectare (4)
	Coral reefs - Range €8,460 per hectare (low technology, low energy environments) to €5.5 million per hectare (5)
	Coral reef - Low-cost transplantation €1,690–10,990 per hectare. With more ambitious goals this rises to about €33,820 per hectare (6)
	Coral reef - Range €6466 - €121 million per hectare; median €1,544,433 for developed countries (42 observations, of which 18 for developed countries) (1)

	Coral reef - Range €5,070 per hectare for nursery phase of coral gardening to €3.4 million per hectare for building an artificial reef, median €338,000 per hectare (1)
Sponges	No information available
Deep-sea corals	Use of landers for colonisation: €408,000 per hectare
	Hypothetical for small scale restoration: > €65 million per hectare (4)
Soft sediment	No information available

Sources indicated in footnote[12]

Benefits

Restoration actions will benefit the whole society, as well as specific economic sectors and stakeholder groups benefiting from particular ecosystem services:

All EU citizens and economic sectors will benefit from the contribution of healthy marine habitats to mitigating climate change and adapting to its impacts, albeit to different degrees, and helping reverse biodiversity loss;

- The fishing sector will benefit from increased catch through the re-creation and conservation of essential fish habitat and ensuing healthy and productive marine ecosystems;
- The aquaculture sector will benefit from improved water quality;
- The tourism sector and recreational users will benefit from enhanced landscapes/seascapes, biodiversity and water quality.

Some examples of the benefits of restoration of certain habitats are given in the table below.

Table VII-4: Estimates of financial benefits of restoration (valuation of ecosystem services to the society and economic sectors)

Habitats	Benefits (per hectare)				
	Regulating and maintenance services (climate mitigation; flooding; erosion)	Cultural services (e.g. recreation)	Provisioning services (e.g. food, water, raw materials)	Socio-economic services	All/ unspecified
Seagrass beds	€95 per ha per year[13]	No financial valuation of ecosystem services available	€866 per ha per year [14]	No financial valuation of ecosystem services available	€284 - 514/ha/yr [15]

[12] Spurgeon (1999) The socio-economic costs and benefits of coastal habitat rehabilitation and creation; Bayraktarov et al., (2016) The cost and feasibility of marine coastal restoration; Groneveld et al., (2019) D7.4: Restoring marine ecosystems cost-effectively: lessons learned from the MERCES project, Marine Ecosystem Restoration in Changing European Seas- MERCES; Papadapoulou et al., (2017) D1.3: State of the knowledge on marine habitat restoration and literature review on the economic costs and benefits of ecosystem service restoration Marine Ecosystem Restoration in Changing European Seas- MERCES; Corinaldesi et al., (2021) Multiple impacts of microplastics can threaten marine habitat-forming species; Knoche et al., (2020) Estimating Ecological Benefits and Socio-Economic Impacts from Oyster Reef Restoration in the Choptank River Complex, Chesapeake Bay.

[13] Tuya et al., (2014) Economic assessment of ecosystem services: monetary value of seagrass meadows for coastal fisheries.

[14] Tuya et al., (2014) Economic assessment of ecosystem services: monetary value of seagrass meadows for coastal fisheries.

[15] Campagne et al., (2015) The seagrass Posidonia oceanica: ecosystem services identification and economic evaluation of goods and benefits.

Kelp + macroalgal forests	US $21 440 680 climate buffer (not per ha)[16]	US $25 957 253 source of scientific information (not per ha) [17]	US $409 527 000 direct harvest (not per ha) [18] US $82 257 712 supporting fisheries (not per ha) [19]	No financial valuation of ecosystem services available	US $434 000 000 per year (not per ha) [20]
Shellfish, mussel + oyster beds	$860 / ha (shoreline protection)	No financial valuation of ecosystem services available	Oyster US $22.8 million (964 acres)19; Oyster US $39 000/year/ 930 ha	Oyster (labour income) $7.8 million (964 acres)19; USD $2.8 million (labour incomes) / 930 ha; $4 123 / ha	$5 500-99 000 per ha per year[21]
Maerl beds, Sponges, Corals, Seeps and vents, Soft sediments	No financial valuation of ecosystem services available	No financial valuation of ecosystem services available	No financial valuation of ecosystem services available	No financial valuation of ecosystem services available	No financial valuation of ecosystem services available

Costs vs Benefits

There are many uncertainties and gaps in knowledge regarding the economic costs and benefits of restoring marine habitats , which limits the accuracy of a cost-benefit analysis. This challenge is recognised in the published literature, where there is a limited number of restoration cost-benefit-analysis for terrestrial and marine ecosystems. Nevertheless, those that do exist clearly show that restoration has a net positive value. For example, Blignaut et al. found that the average benefit-cost ratio varies between 0.4 (coral reefs, seagrass meadows) and 110 (coastal wetlands), with most biomes recording an average benefit-cost ratio of 10, with similar cost-benefit ratios observed in other systems, including between 0.4 to 15.7 for oyster reefs. In a theoretical study, the economic benefit of restoration and conservation of marine life in the world's ocean is estimated to be 10 times higher than the expected costs.

Looking at the costs and benefits for certain affected sectors, in the short term, the fisheries will be the most impacted stakeholder group in terms of potential lost income. However, a recent analysis by the International Council for the Exploration of the Sea (ICES) shows for example that 90% of the value of the catch by bottom fishing is obtained from just 30-40% of the total area fished. ICES consequently recommends that efforts to reduce the impacts of fishing on seabed habitats should focus on removing bottom fishing from the 'peripheral' fishing areas that yield only 10% of economic value, and continuing to fish in the more profitable 'core' fishing areas which generate 90% of the catch value. This general strategy offers a way to reconcile the need to protect seabed biodiversity and its carbon sequestration capabilities with the need to maintain the sector's socio-economic viability. The potential direct costs of removing bottom fishing from 'peripheral' fishing areas, for example to achieve a 30% area undisturbed by bottom fishing, would

[16] Vásquez et al., (2014) Economic valuation of kelp forests in northern Chile: values of goods and services of the ecosystem.
[17] Vásquez et al., (2014) Economic valuation of kelp forests in northern Chile: values of goods and services of the ecosystem.
[18] Vásquez et al., (2014) Economic valuation of kelp forests in northern Chile: values of goods and services of the ecosystem.
[19] Vásquez et al., (2014) Economic valuation of kelp forests in northern Chile: values of goods and services of the ecosystem.
[20] Vásquez et al., (2014) Economic valuation of kelp forests in northern Chile: values of goods and services of the ecosystem.
[21] Grabowski et al., (2012) Economic valuation of ecosystem services provided by oyster reefs.

require a 3.9% reduction in fishing effort, resulting in €88m reduction in gross landings value for the studied area. This direct cost would be partially offset by shifting some fishing activity from peripheral to core fishing areas, and by increased catch per unit effort through fuel and fishing time savings. Furthermore, there is evidence that a number of fisheries may benefit from increased catch in the medium to long term through the re-creation and restoration of essential fish habitats. Finally, EU funds are available to reduce the impact on the sector. This indicates that restoration efforts through removing pressures could be done in a way which is acceptable for different stakeholders.

7.5 Synthesis

- The state of the European seas is poor and biodiversity loss has not been halted. A high proportion of marine habitats protected under the Habitats Directive are in unfavourable conservation status or declining and the pressures affecting them are increasing. Under the Marine Strategy Framework Directive, all EU marine waters have not reached good environmental status in 2020. Faced with the increased threats posed by overexploitation of marine resources, pollution and climate change, urgent action is needed to bring them back to good condition through large-scale restoration of marine ecosystems.

- Restoration of habitats can be a particularly effective way to achieve the recovery of whole marine ecosystems, including species. Science shows that restoring marine habitats (where species live, reproduce and forage) both sets the enabling conditions for species and ecosystems to thrive and allows delivering enhanced ecosystem and societal services. Several groups of habitats were prioritised for restoration because they have the capacity to contribute substantially to the restoration objectives under the Biodiversity strategy, in particular towards mitigating climate change, reducing the impact of natural disasters and bringing health, social and economic benefits.

- Since the broad habitat types as defined under the existing directives would not result in the necessary focus of restoration action in accordance with the priorities in the Biodiversity strategy, it is proposed that the selection of the habitat types in each group is done according to the European nature information system (EUNIS) to ensure equal interpretation across regional seas.
- The proposed target therefore entails a step-wise implementation of the necessary restoration measures to improve all areas of selected habitat types that are not in good condition to good condition, with incremental targets for 2030, 2040 and 2050. Setting the targets at national level and assessing the progress of restoration actions will require additional data collection, however, there are already many relevant monitoring frameworks and guidelines in place.

- The benefits of restoration to biodiversity and fisheries have the potential to be realised within a decade (varying by habitat) whilst the benefit of restoration to climate change adaptation and mitigation and pollution effects may take multiple decades. However, the long-term benefit to society and nature means action should start as soon as possible, even if the benefits are not immediate.

- Effective, representative and coherent networks of marine protected areas (MPAs) can be vital in restoring degraded marine habitats to good condition and ensuring that they don't degrade again.

- High variability in the costs and benefits of restoring habitats and the lack of a baseline to determine the area needing restoration means it is not possible to undertake any accurate cost/benefit analysis. However, whilst the evidence is limited, the benefits of restoring marine ecosystems outweigh the costs. Though there may be some short-term losses to certain economic sectors, these are outweighed by the long-term gains.

8. Urban ecosystems

8.1 Scope

The urban ecosystem is defined as *'the ecological system located within an area of high to moderate population density that is composed of physical and biological components that interact with each other'*. (Maes et al., 2013, 2018, 2020).

For the purposes of this impact assessment, the reporting units for urban ecosystems are broken down according to 'local administrative units' (LAUs), which are low-level administrative divisions of a country below that of a province, region or state. (established in accordance with Regulation (EU) 2017/2391 on 'Territorial Typologies'[22]) These LAUs are classified in line with Eurostat definitions of municipalities and communes[23] as cities (areas of high population density), towns and suburbs (areas of medium population density) and rural areas (areas of low population density). This impact assessment will consider those LAUs classified as 'cities' and 'towns and suburbs' in the LAU dataset of 2020 (the most up to date available[24]).

Figure 1 shows the distribution of LAUs classified as **'Cities' and 'Towns and suburbs'. Together they represent 21.5 % of the area of the EU territory. (**City LAUs covering 3.7% and towns and suburb LAUs 17.8%**)**. City, and town and suburb LAUs are where more than 73% European citizens live: respectively 39.4% in cities and 34% in towns and suburbs. (JRC 2022[25]) The average EU make-up of land cover classes inside these LAUs, is as follows:

Class	**Km2**	**% of LAUs**
Artificial surfaces	111,044	12.5
Agricultural areas	425,233	47.8
Forest and semi-natural areas	315,460	35.5
Wetlands	7,514	0.8
Water bodies	30,047	3.4

[22] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32017R2391
[23] https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/ks-02-20-499
[24] dataset corrected to remove LAUs misclassified as 'cities', 'towns and suburbs'.
[25] data used for the calculation: see references at end of chapter.

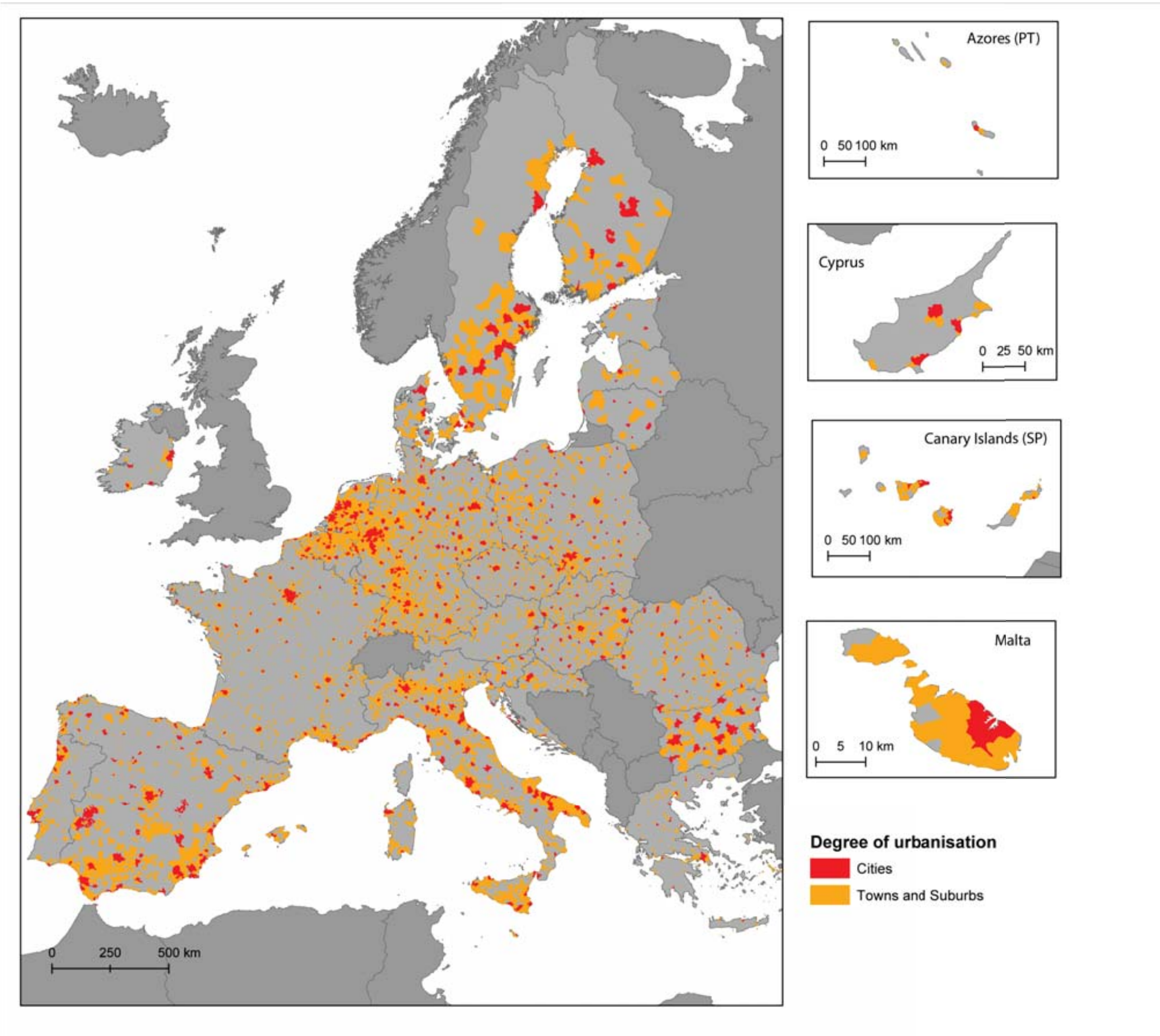

Figure 1: Map of the distribution of LAUs classified as 'Cities' and 'Towns and suburbs'.

The EU has experienced an increase in the area of urban 'artificial surface' over the last 20 years averaging 3.4 % per decade (2000 – 2018). Between 2019 and 2050, the overall urban population is projected to increase in 15 EU Member States, ranging from +2.3% in Croatia to +35.4% in Malta. Along with Malta, Ireland and Sweden are also projected to record increases of more than 20% in their overall urban populations (+29.2% and +25.1% respectively)[26]. Additional housing and infrastructure will need to be built to accommodate this growth. Overall urbanization is considered to be the second largest pressure on terrestrial and marine ecosystems (EEA 2020). It will not be feasible to address loss of green areas and biodiversity without improving the condition of 'managed' urban ecosystems as they grow. Therefore it is critical to ensure new development is undertaken in a way that protects and enhances urban ecosystems, rather than the opposite and that policies are implemented at the local level that enhance and restore urban ecosystems.

[26] https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210520-1

Urban ecology and the study of urban ecosystems are important for the following reasons: urban environments are extensive and growing; the nature of urban environments affects the health and wellbeing of their human inhabitants[27]; they are influence the conservation of biological diversity; they have an impact on their close surroundings (McPhearson et al. 2018); and they have an impact across boundaries on other cities or other ecosystem types. Achieving European and international goals for biodiversity will partly depend on the policies and actions deployed in urbanized regions of the world.

The 2020 MAES EU ecosystem assessment[28] has the following to say on Urban Ecosystems:

When focusing on the balance between abrupt greening (defined as a relatively sharp upward trend in urban vegetation) and browning (defined as a relatively fast loss in urban vegetation), cities are not able to compensate for land taken. This means that when a loss of vegetation is observed (usually due to land use change, i.e. housing or infrastructure policies) there is no corresponding compensation strategy in place to recover the vegetation within the green infrastructure. This can result in progressive increase in fragmentation of semi-natural patches and consequential loss of city resilience. Cities and their surroundings can be part of the solution. They can host biodiversity spots and Urban Green Infrastructure (UGI) can deliver important benefits and be part of a regional eco-networks.

However, defining a clear role of urban ecosystems within sectoral EU legislation and policies is required. Clear rules need to be set to compensate for land taken and vegetation loss. Moreover, there is a need for setting targets to specifically monitor urban condition, urban biodiversity and urban their ecosystem services.

The capacity of urbanized areas to support ecosystems varies widely and is related to their configuration and to the structure and extent of their Urban Green Infrastructure (UGI), and to what extent they incorporate 'nature-based solutions' to address local societal challenges. (Babí Almenar et al., 2021; Beninde et al., 2015; Ingo Kowarik, 2011; Pellissier et al., 2012; Xie & Bulkeley, 2020).

- 'Urban Green Infrastructure' is defined as: *"a strategically managed network of urban green spaces and natural and semi-natural ecosystems situated within the boundary of an urban ecosystem"* (European Commission 2013).

- '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"*. (European Commission 2015, 2016)

Urban development does not have to have a negative impact on biodiversity, it can have a positive local impact in existing urban ecosystems, while still providing the local services needed by humans in them.

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[27] Sarkar and Webster 2017, Gascon et al. 2016, Gascon et al. 2017, Dadvand et al. 2016, van den Berg et al. 2016, Tischer et al. 2017

[28] https://publications.jrc.ec.europa.eu/repository/handle/JRC120383

Political context

The EU Biodiversity Strategy to 2030 seeks the *"greening of urban and peri-urban areas"* and calls on European cities of at least 20,000 inhabitants to develop ambitious Urban Greening Plans by the end of 2021. Previously, the European Commission's EU Environment Action Programme to 2020 (7th EAP) committed to having policies in place by 2020 to achieve 'no net land take' by 2050 and has also set targets for reducing soil erosion and the loss of soil organic matter.
On a global level, world leaders at Rio+20 (the United Nations Conference on Sustainable Development) argued that urgent action is needed to halt land degradation, given the increasing pressure on land from agriculture, forestry, pasture, energy production and urbanisation. They agreed to strive to achieve zero net land degradation (UNCCD, 2012)

While land take can be defined generally as the loss of undeveloped land to human-developed land, it can also be defined as the loss of agricultural, forest and other semi-natural and natural land to urban and other artificial land. This includes areas sealed by construction and urban infrastructure as well as urban green areas and sport and leisure facilities (EEA, 2006**). Since the 1950s, EU land take has largely been driven by urban sprawl. As well as a simple conversion of land from non-urban to urban use**, sprawl is characterised by a decrease in urban density, a decentralisation of urban functions and the transformation of a compact urban form to an irregular, discontinuous and dispersed pattern (Siedentop and Fina, 2010).

The targets proposed within this impact assessment will however focus on the implementation of the objectives of the biodiversity strategy, and the restoration of urban ecosystems – not on land take. Any biodiversity targets should not aim at preventing or halting growth of urban areas, but rather **promoting *biodiversity-positive* growth**, ensuring urban ecosystems are protected, enhanced and restored. Specifically, targets will ensure that when urban planning decisions are made, the green spaces and tree canopy cover of urban ecosystem are taken into account, and that their multiple services are not undervalued. In other words, urban planning should not only prioritise new developments that have the lowest environmental impact on local urban ecosystems, but also ensure that they actually enhance them. To achieve this balance of enhancing urban ecosystems while allowing for greening urban development means that the levels and timeframe of any targets is critical.

The nature and level of the targets also needs to be considered carefully within the context of other relevant EU policies that have an impact on the development and greening of cities including *inter alia:* climate, energy and adaptation plans, the Horizon Europe Cities mission, sustainable urban mobility plans (SUMP) and logistics (SULP) and noise action plans, air quality plans (AQP), land-use and waste/waste water management. Many of these policies already promote urban greening for the many benefits it provides.

8.2 Problem, current trends and ecosystem-specific baseline

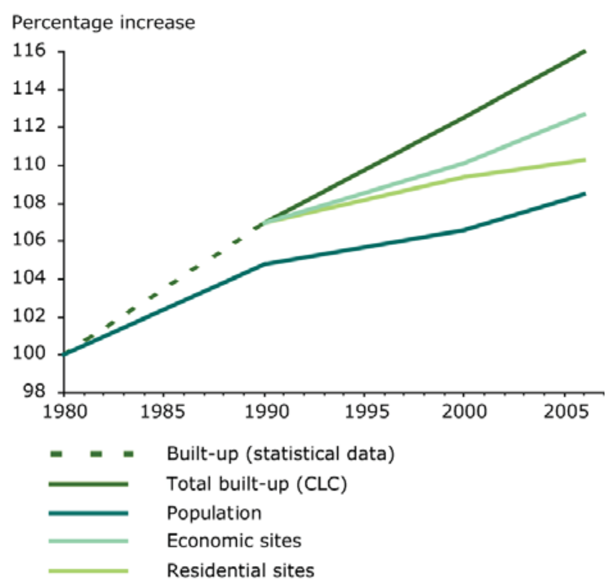
Land is the ultimate common resource as it provides habitat for flora and fauna, is the basis for most human activities and supplies the resources for meeting most human needs. It is the space required for living, as well as natural space, cultural space, economic space, and recreational space.

When natural land is built over without due care and attention, the surface of the ground is sealed and most ecological functions are permanently destroyed. Infrastructure costs, noise, and the distance between home and work all increase while carbon pools, open landscapes and biodiversity hotspots are lost. All efforts for sustainability will ultimately fail if land use is not organised in a sustainable way.

Cities and Towns constitute a highly altered ecosystem, and one most steadily degrading. At the same time urban green spaces provide many vital services such as: protecting and enhancing biodiversity; supporting pollinators; providing green corridors for wildlife; cooling urban space; flood protection; mental and physical wellbeing and recreation; as well as filtration of air and water. water (La Notte and Zulian, 2021; Haase et al 2024; Marando et al 2022; Marando et al 2016)

Important pressures on urban ecosystems are related to habitat conversion and land degradation, pollution (air, water and noise pollution) and unwanted introduction of invasive alien species. (Ferreira et al. 2019, Kondratyeva et al. 2020, Villalobos-Jiménez et al. 2016, Marzluff et al. 2008)

The graph below depicts the steady growth in built-up area and population increase in 25 EEA countries[29] up until 2006. This trend has broadly continued since and is predicted to continue into the future.



With continued urban growth and development in Europe comes a growing pressure for land, and in general, this has meant that green spaces in and around cities have been steadily replaced with grey over recent decades.

[29] https://www.eea.europa.eu/articles/analysing-and-managing-urban-growth

This simple approach has been the easiest and cheapest one for the rapid development of urban areas in the short term. The result is the degradation of urban ecosystems, and of the many valuable services they provide: a loss of valuable habitats for species including pollinators and birds; an increased urban runoff rate and higher risk of flooding and associated waste water pollution into EU rivers; significantly higher urban temperatures in summer due to a loss of microclimate regulation services and climate change mitigation potential; a loss of pollution filtration for air and water; and the loss of local recreational services (Marando et al., 2022; Seppelt et al., 2011).

Urban development, undertaken without due consideration of the urban ecosystem, considerably decreases the intactness of habitats, through the conversion of natural and semi-natural land, and through the fragmentation of the landscape caused by transport connections and other hard infrastructure - critically affecting the species depending on these habitats (EEA, 2020).

Trends in LAUs classified as 'cities' and 'towns and suburbs

According to the MAES Ecosystem assessment, Europe has experienced an increase of all artificial land cover types over the last 20 years by 3.4% per decade in the long term ("Urban" consists of all artificial land cover types included in Corine land Cover Map (Level 1)).

There has also been a steady reduction in urban green space, over recent decades. By year we see the following averages:

i. Increase of urban areas (artificial surface) **0.34 % per year**
ii. Loss of urban green space and tree canopy cover per year: **0.1% per year**

The MAES report says: "*One proxies of land degradation were soil sealing*" and that "*The share of sealed soil is significantly increasing in core cities, both in densely built areas and even more so in not-densely built areas where there are still opportunities for alternative solutions for dealing with territorial development.*"

The overall trend then is one of steady expansion of urban fabric. New development has tended to be on agricultural land in urban fringes, (around 50%) with only around 12-13% of new developments on brownfield (abandoned) sites in cities. The remaining expansion is into natural and semi-natural areas including forests.

Some projections used for assessing the 'business as usual scenario' are shown below, that show what the situation would be if trends seen since 2000 were to continue (assuming no new policy action at EU of MS level) :

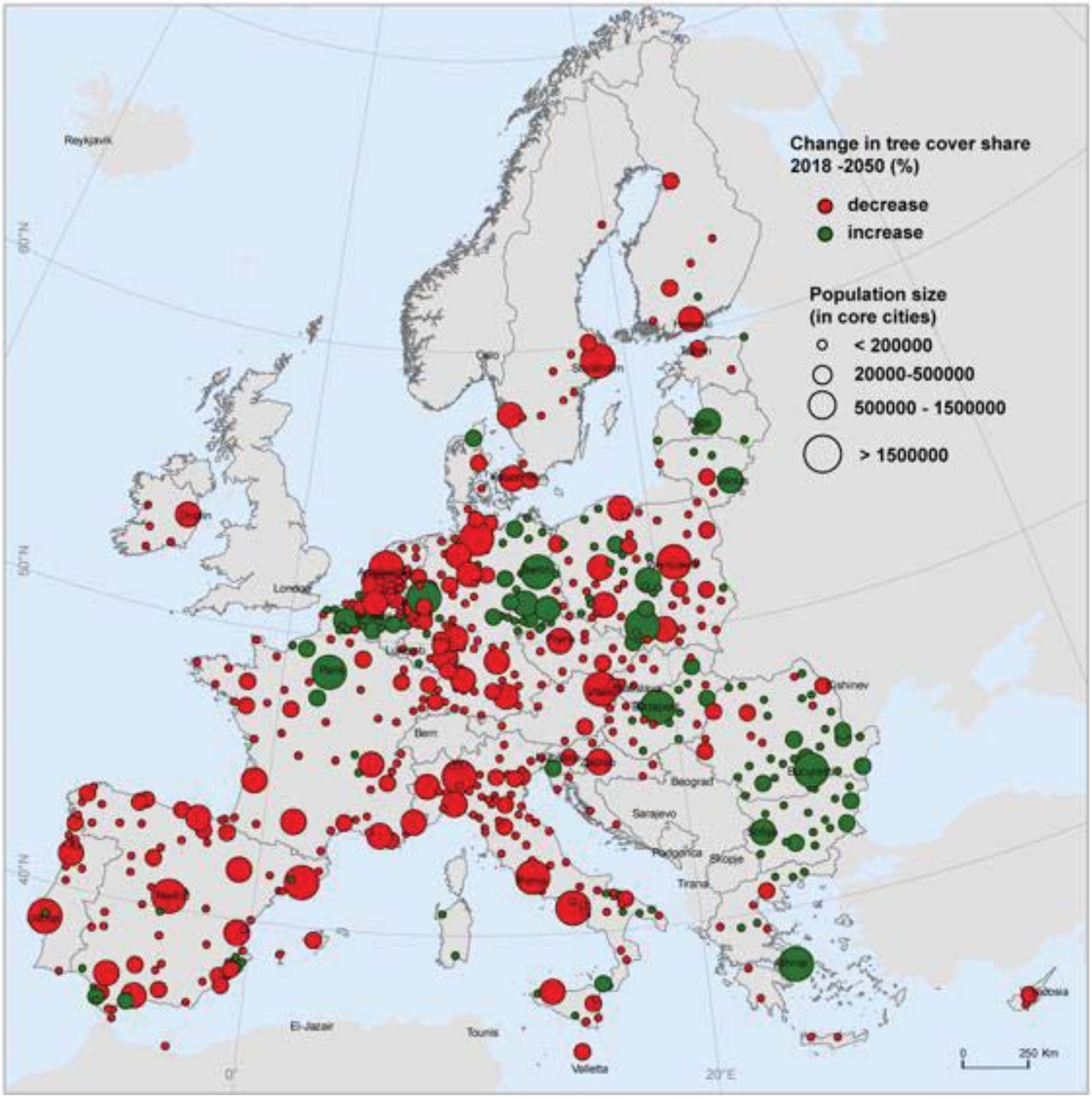


Figure: BAU scenario: Projected change in tree cover within functional urban area between 2018 and 2050 (JRC 2021)

Here we see that across a majority of MS and their urban areas are likely to continue to see a loss of tree canopy cover if no further policy action is taken. Details per Member State are show below.

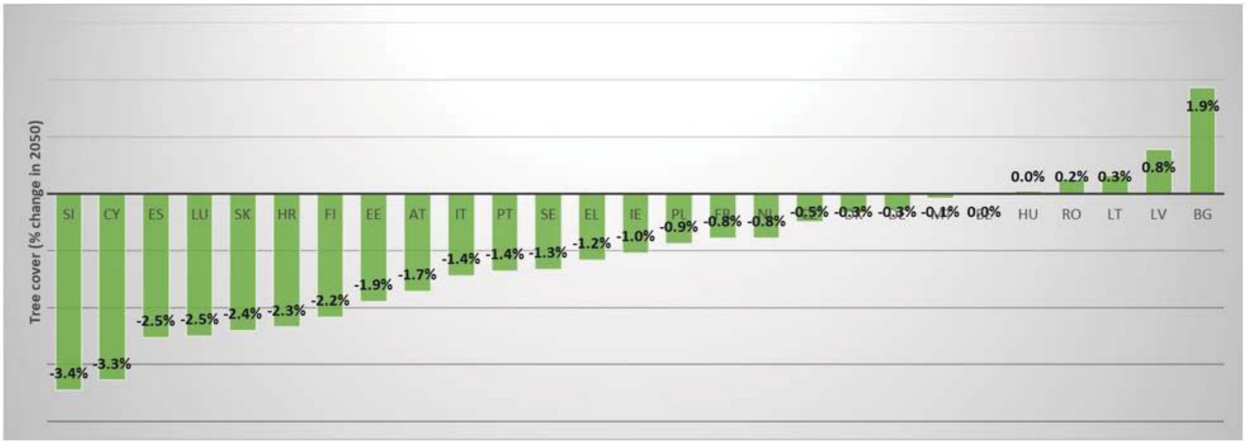


Figure: BAU scenario: Projected change in tree cover within functional urban area between 2018 and 2050 at MS level (JRC 2021)

It is clear that the competition for land in urban areas has, and will continue, to rise overall, with growing urban populations forecast across the EU. However, designing cities and towns and undertaking urban planning and development in an integrated way can however protect and actually enhance urban biodiversity and help maintain the many ecosystem services they provide, without restricting growth. Brownfield remediation and regeneration, for example, may represent a valuable opportunity, not only to prevent the loss of pristine countryside, but also to enhance urban green spaces, tree cover and remediate contaminated soils.

According to Haaland,et al. (2015) the most important barriers for cities implementing green urban development plans (that integrate ecosystem restoration objectives) are:

- The lack of integrated urban planning strategies incorporating ecosystem thinking. (and therefore a lack of coherence across urban departments *inter alia* water, transport, housing, education etc);
- Pressure for housing / development, and scarcity of land;
- Availability of funding for integrating greener urban development aspects;
- Lack of awareness of the benefits of investing in nature and ecosystem restoration.

There is now, however, a growing awareness of the potential of using nature-based solutions to address key urban challenges, and an increasing body of evidence evaluating and demonstrating the multiple/co-benefits they offer when compared to comparable technical/industrial scale solutions (European Commission, 2021). A number of actions considered highly valuable, which are founded on ecological principles, connectivity and natural regeneration are set out below:

- Integrating ecosystem thinking/accounting into urban planning processes, to realize the multiple benefits of NBS over alternatives, and to protect and enhance biodiversity;
- City regeneration — including rehabilitation of vacant buildings, degraded city districts and green spaces;
- The protection and maintenance of existing trees and the planting of new trees and woodlands;

- Creating large scale regional parks and forests in the urban fringes.
- Planning for urban green corridors to ensure a robust and functional network of green infrastructure;
- Improving the quality and function of existing green and blue infrastructure through multiple management modes;
- Using appropriate green and blue infrastructure as an integral component of new developments;
- Improve connectivity and accessibility to green and blue infrastructure within the city and beyond;
- Improving and promoting a wider understanding and awareness of the benefits that green and blue infrastructure provides;
- Encouraging ecological management mode of private green areas (including *inter alia* enhancing/improving the biodiversity value of existing green spaces, and providing green roofs and walls)

Currently **urban ecosystems are not specifically covered by any existing targets for ecosystem restoration**, although some areas covered by the Habitats Directive are found in urban areas. There are more than 12 thousand *Natura 2000* sites within, or partly within, city, and town and suburb LAUs. Protected areas within cities, towns and suburbs represent 16.65 % of the total area of the *Natura 2000* network. (Of which 2.4% are within cities and 14.2% are inside towns and suburbs[30].)

While many local / city urban greening plans do exist, and while many local authorities are taking action to protect and enhance urban ecosystems, these actions are, at the European level, mostly not coordinated, sporadic and insufficient overall – in short they provide no guarantee that urban ecosystems will not continue to degrade in the EU overall. At present, in many local administrations there are no drivers to implement urban greening measures, or if there are, they is significantly outweighed by the pressure for quick short-term development. The result of failing urban ecosystems is not only urban spaces themselves, but also on their surroundings and on the wider EU environment. For example, degraded urban ecosystems offer poorer levels of water filtration and flood protection, meaning significantly increased river pollution. They also do not support biodiversity effectively, both locally and more widely, including migrating birds and pollinator species.

There some important EU and international targets closely related to urban ecosystem degradation, including a number of SDG targets, *inter alia*:

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."*

Including the following specific targets:

[30] Data: Natura 2000 (2018); LAU-DEGURB version 29/06/2021: https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/population-distribution-demography/degurba

- *15.3: "….restore degraded land and soil…..and strive to achieve a land degradation-neutral world"*
- *15.5 "Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity…"*
- *15.9 "By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes…"*

SDG 11: *"Make cities and human settlements inclusive, safe, resilient and sustainable"*

Including the following specific targets:

- *11.6: "By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management"*
- *11.7 "By 2030, provide universal access to safe, inclusive and accessible, green and public spaces…."*
- *11.a: "Support positive economic, social and environmental links between urban, per-urban and rural areas by strengthening national and regional development planning"*
- *11.b: "By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters…"*

The 7th EAP sets the target that *"By 2020, EU policies take into account their direct and indirect impact on land use in the EU and globally, and the rate of land take is on track with an aim to achieve no net land take by 2050; soil erosion is reduced and the soil organic matter increased, with remedial work on contaminated sites well underway."*

However, in spite of these aspirational, voluntary, targets, there is no evidence of an overall change in the direction of the trends seen over recent decades. If they are to be achieved, coordinated policies or action at national and/or EU is considered essential - and thus the need to consider some urban ecosystem restoration targets with the aim of resorting urban ecosystems, by steadily steering urban planning towards systematically integrating urban ecosystem thinking into their processes.

8.3 Target options screened in/out

Based on the above considerations several legally binding targets options were proposed and assessed for protecting and restoring urban ecosystems in LAUs classified as 'cities', and as 'towns and suburbs'. Various targets were considered related to urban sprawl/soil sealing; to urban green space; and finally to tree canopy cover (being a sub-set of urban green space).

For all options, high quality Copernicus satellite data is already available going back to 2000, and will be available every three years through future 'Corine Land Cover' analysis that provides information on urban growth, soil sealing, tree cover density, and various layers of urban green, down to the 10m² level of detail. This data can very easily be assessed within the relevant reporting units (in this can LAUs: cities, towns and suburbs) and is available freely online. It can be used for setting the baselines and for measuring and monitoring the targets.

The aim of the screening process was to select options for assessment that would be **realistic and feasible** for Member States and their growing urban populations, **while ensuring that the steady decline in the quality of urban ecosystems over recent history was addressed**, and then over time, **reversed**.

Some of the key data for establishing and assessing the various target options is set out below:

Key figures (JRC 2022):

Totals (2021)

iii.	Total area of LAUs 'city'+ 'town and suburb':	**890,000 km²** *(21.5% of EU surface)*

of which:

iv.	Area of LAUs classified as 'city':	**152,870 km²** *(3.7% of EU surface with 32.7% of EU population)*
v.	Area of LAUs classified as 'towns and suburbs':	**737,130 km²** *(17.8% of EU surface with 28% EU population)*
vi.	Area of green space in LAUs 'city'+ 'town and suburb':	**320,000 km²**
vii.	Area of tree cover in LAUs 'city'+ 'town and suburb'	**230,000 km²**

Trends *(averages since 2000)*

viii.	Increase of urban areas (artificial surface)	**0.34 % per year**
ix.	Loss of urban green space and tree canopy cover per year:	**0.1% per year**

Potential land availability

Two main types of potential land availability have been considered below for analysis, aimed at supporting the selection of suitable targets for urban ecosystems, these are: levels of abandoned land, and the rate at which urban building stock is renewed and renovated. Together these give an idea as to the types of actions which could support enhancing urban green and increasing tree canopy cover, i.e. by ensuring residential, commercial and industrial developments are 'greened' over time (such as green roofs, green permeable parking, provision of parks and gardens) and by ensuring that brownfield sites (i.e. abandoned and/or contaminated urban land) is restored and used for parks and gardens or for new developments (rather than building on semi-natural habitats or forests).

It is important to note that around half of new urban development takes place on agricultural land in urban fringes. Clearly this agricultural land provides important environmental, social and economic services. It also offers potential for biodiversity restoration, addressed through, for example, greening measures in the Common Agricultural Policy; policy actions set out in the EU soil strategy for 2030; and within other targets in the nature restoration law. In some cases abandoned agricultural land (data on levels of such land are presented below) may offer opportunities for greening/tree planting in and around cities. As such, the aim of this assessment is to set targets to ensure the protection and restoration of urban ecosystems – any targets should work in conjunction with, and be supported by, any greening and enhancing the biodiversity value of peri-urban agricultural land. (i.e. such greening should count towards any urban ecosystem targets). Bastin et al (2020) estimate that the total area of abandoned agricultural land in the EU is as much as 116,410 km², but do not give any figures for what proportion of this can be found in city and town and suburb LAUs. Given, however, that these LAUs represent more than 20% of the EU land surface and contain around 50% agricultural land, the levels of abandoned land in these LAUs could be significant.

Potential of abandoned artificial land.

Land availability (source: Bastin et al., 2020, JRC 2022)

i.	Total **artificial surface** inside LAUs classified as cities and towns:	**110,000 km²**
ii.	**Abandoned land** in this artificial surface:	**7,468 km²**
iii.	Land without current use (in Functional Urban Areas):	**1,532 km²**

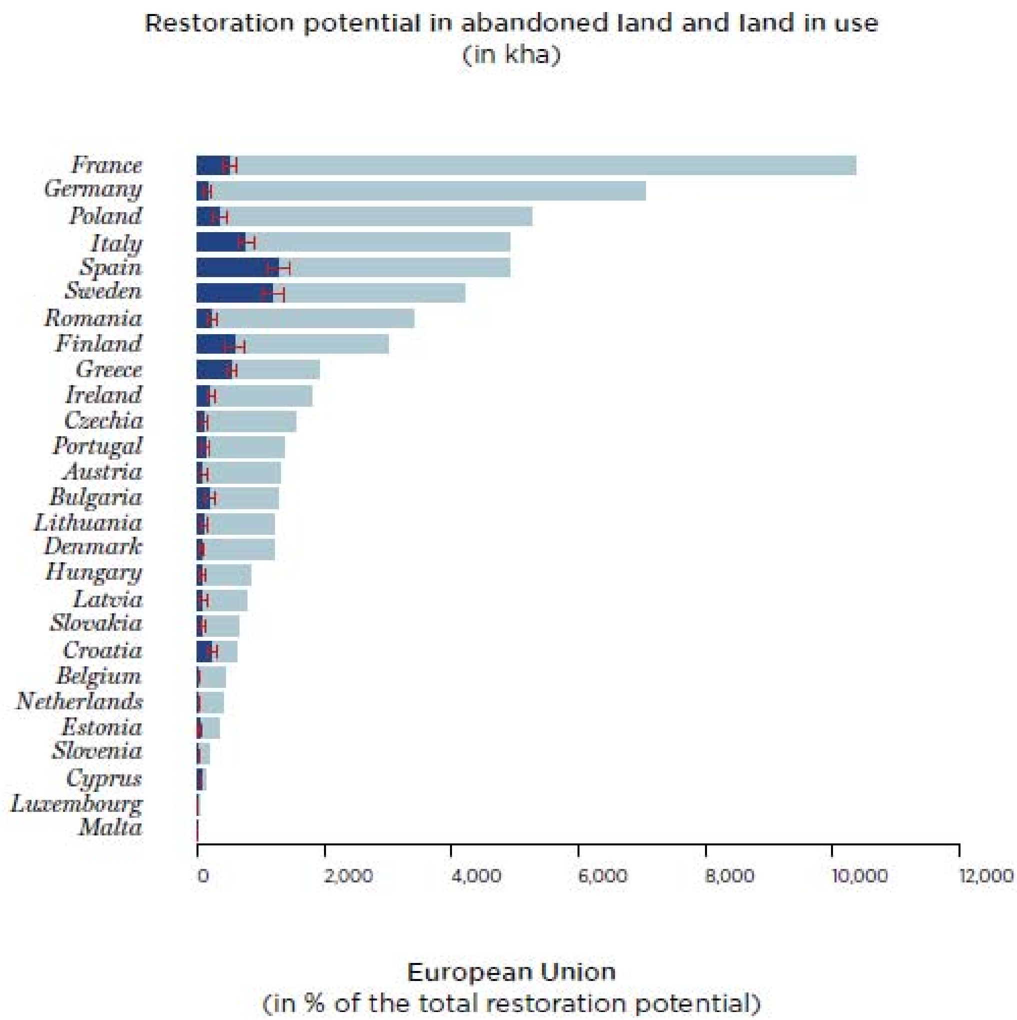
'Brownfield' sites are derelict and underused and include abandoned former industrial or commercial sites, which may have real or perceived contamination problems (EC, 2012). Redevelopment of brownfield sites gives many environmental advantages: relieving pressure on rural areas and greenfield sites, reducing the costs of pollution, allowing more effective use of energy and natural resources and facilitating economic diversification. (EEA, 2016). The European Environment Agency (EEA) has estimated that **there are as many as three million brownfield sites across Europe** and the figures above show that there are significant areas of abandoned sites in artificial land surface with potential for greening or for urban development. Of the figures above it is not only the abandoned land with potential for greening and tree canopy cover. In use artificial surface also clearly has potential for greening too, such as by:

- Planting additional trees (tree lined streets/corners/roads/etc., enhancing existing parks with trees, tree planning on brownfield sites around cities)
- Developing new public parks and gardens (i.e. in urban fringes, conversion of brownfield)

- Maximising green space on new and/or redeveloped sites (green roofs, greener more permeable parking etc.)

Brownfield sites are often located within urban boundaries with good connections to local infrastructure, making them a competitive alternative to greenfield investments.

Bastin et al (2020) estimate the total land available for restoration for tree canopy cover in all EU artificial surfaces (about 75% of which fall in LAUs classified as cities, and towns and suburbs) of both ‘abandoned’ and ‘in use’ land, at around **40,500 km².** Below is a figure showing the distribution by MS of this restoration potential by Member State.



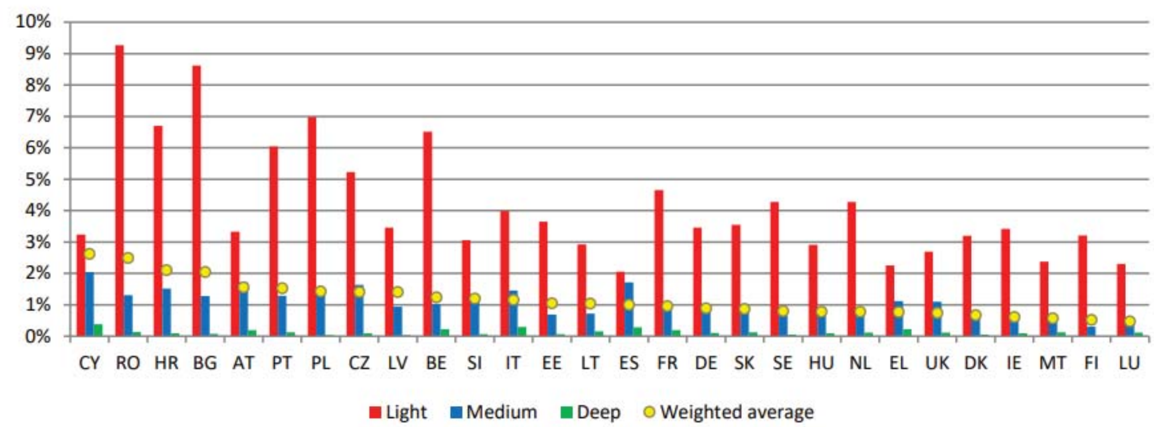
Potential for greening linked to renovation of buildings.

Renovation rates[31]

i. Average residential: **1% per year**
ii. Average non-residential: **1.2% per year**

For **residential buildings**, the annual weighted renovation rate is estimated at 1.0%. Results show important variations between Member States. In general, values are higher in Eastern – European Member States, possibly as a result of the high renovation rates on light renovations.

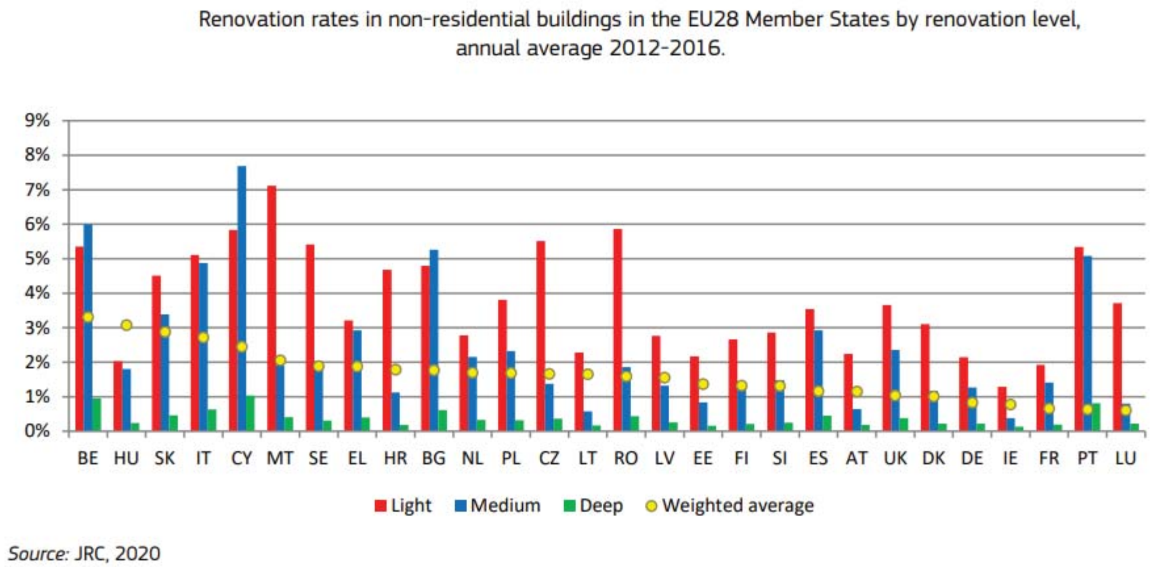
Renovation rates in residential buildings in the EU28 Member States by renovation level, annual average 2012-2016.



Source: JRC, 2020

For **non-residential buildings**, the annual weighted energy renovation rate was estimated to 1.2%. The weighted average also shows variations between Member States ranging from 0.6% in Luxembourg to 3.3% in Belgium.

[31] https://ec.europa.eu/energy/sites/ener/files/documents/1.final_report.pdf , https://publications.jrc.ec.europa.eu/repository/handle/JRC122347



Converting renovation rates into potential for urban greening:

Total artificial surface in LAUs classified as city, and town and suburb fit for renovation[32]:

Residential plots:	55,143 km^2
Non- residential plots:	21,472 km²
Total:	76,615 km²

If the **average** renovation rate is considered (which included deep, medium and light renovations) the figures are 551 km² per year for residential and 258 km² per year for non-residential. This represents a total of 20,200 km² over 25 years.

Assuming that a renovated building plot could increase its green area (via, for example, green roofs, greening parking places, tree planting, adding green recreational land etc) by a factor of 0.25 to .5, we can see a rough range of potential additional urban greening of **5,000-10,000 km² over a 25-year period**.

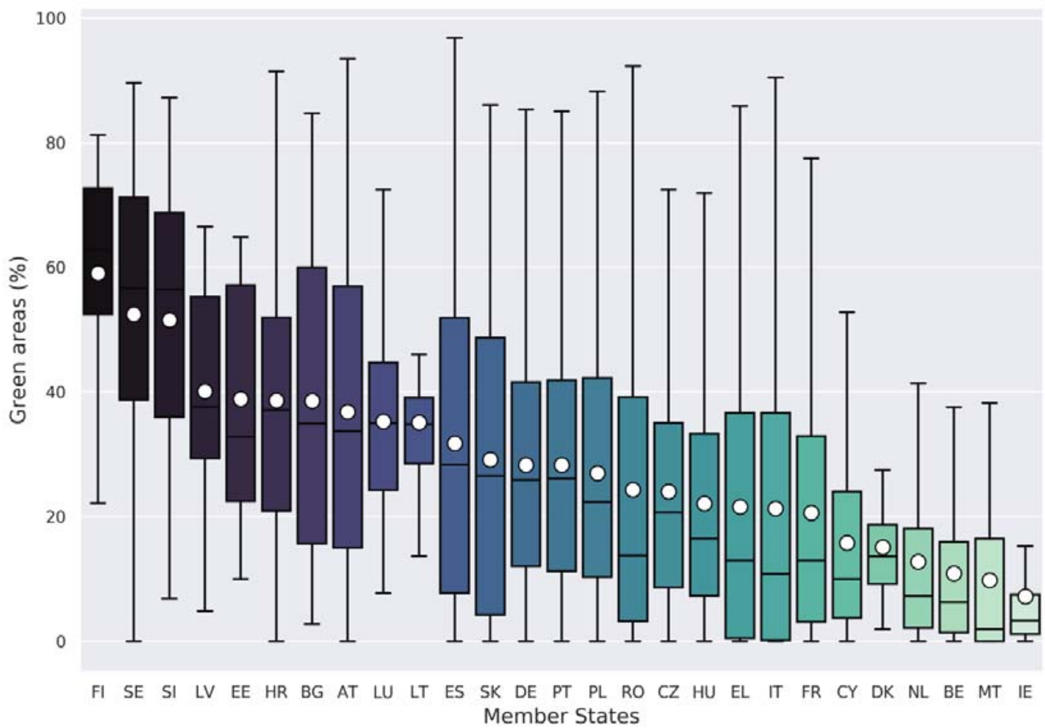
In addition to looking at land availability and renovation rates, the following tables show the current variation by Member State in terms of urban green space and tree canopy cover. This information, in combination with the data above, was used as the basis for setting the targets for this assessment.

<u>*Urban Green:*</u>

[32] *Values based on artificial surface not classified as road, harbour or railway, so includes courtyards, private plots not occupied by buildings and therefore some building plot open space. (JRC 2022)*

Urban green spaces provide several key regulating, cultural and provisioning ecosystem services, such as microclimate regulation, flood control, air quality regulation, noise pollution mitigation, nature-based recreation. Urban green is the amount and extent of vegetation that composes an urban green infrastructure. It is represented by public and private green spaces, characterized by different uses and management practices.

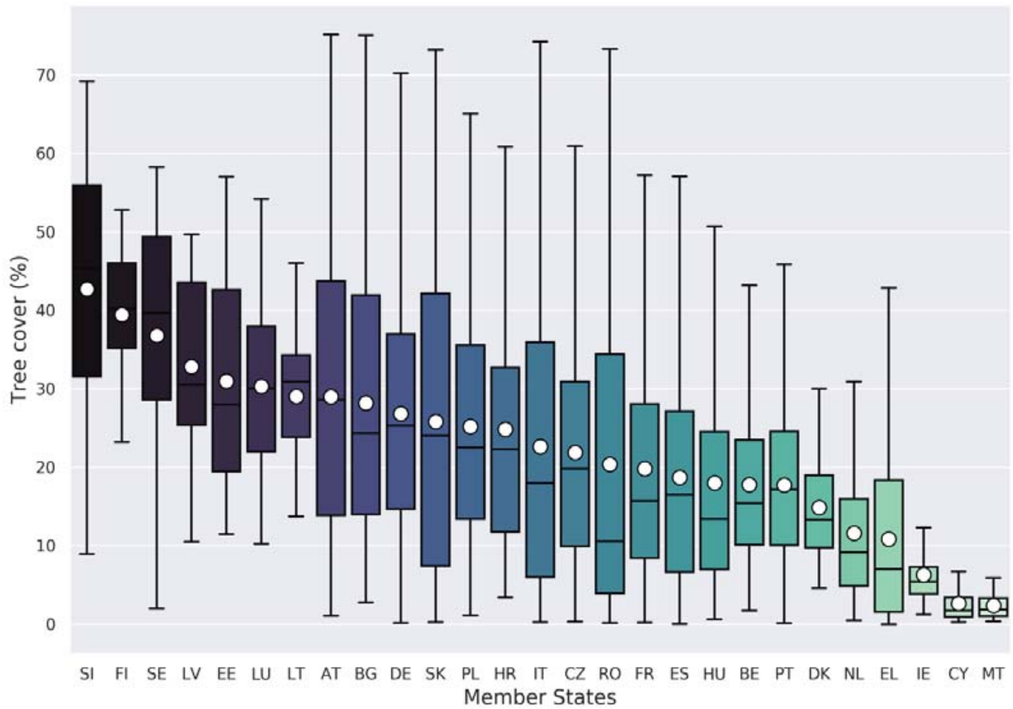
Below: the distribution of the share of green areas in EU Cities, Towns and suburbs, represented by Member State (data: Corine Land Cover).



Here we can see that the levels of urban green vary greatly by Member State, ranging from an average (white dot) of nearly 60% green space in some LAUs, down to as low as 10% in others. The range of green space within the LAUs in each Member States (95% of LAUs are represented in the bar for each Member State) also shows that there is significant variation within country borders too.

<u>Tree canopy cover:</u>

Below: the distribution of the share of Tree canopy cover in EU Cities, Towns and suburbs, represented by Member State (data: Copernicus HRL Tree Cover Density map 2018).



For tree canopy cover we see a similar pattern to that of urban green, (tree canopy cover is often a sub-set of urban green, so this is not surprising) with the range of average tree cover in city, and town and suburb LAUs from nearly 45% down to around 2% in some smaller island Member States. Again, the variation within the LAUs of each MemberState is also broad, with some showing more than 30% differences. Overall 11 Member States have at least some LAUs with less than 10% tree canopy cover.

The reasons for these variations for both urban green space and tree canopy cover are diverse, ranging from the geographical to the historical, as well as partly being related to the manner in which Member States establish their administrative boundaries within the confines of their borders. It is very important to stress that **these numbers do not directly represent or show 'good' vs 'bad' historical urban planning practices**. Some LAUs have much longer histories, some are smaller and confined more to city limits, and at the same time the local climate and native vegetation and tree cover vary greatly across the EU.

All cities, towns and their suburbs should address this loss of green space and tree canopy cover in the future if our biodiversity (and many other climate and environmental) objectives are to be met at least by ensuring new developments and renovations are greened as far as possible, and that abandoned land is prioritised over pristine natural habitat.

Some of these urban areas should also be the focus for funding, and policy action, in relation to the 2030 target of planting an additional 3 billion trees, so setting the targets with consideration of this overarching EU climate and biodiversity objective is also relevant.

Based on the analysis and data shown above, looking at existing levels of green and tree cover, how they are distributed across Member States, and the trends in recent history, and taking account of how important urban ecosystems are, for biodiversity and for society – but also taking into account the very different histories, natural climates of our urban areas - an effective approach to setting a target on green space and trees is first aim to halt the their decline, and then to encourage a steady and positive growth. Halting the loss in green and trees in many LAUs will not be difficult, and some are even already on this path, however for others it will require some change in planning processes, integrating and prioritising the protection of green space and restoration and greening of new developments and restorations.

To ensure a fair and feasibly approach for restoration across cities, such that those who already have higher levels of green space are not penalised for this, the targets proposed are set relative to the total area of each LAU, rather than relative to existing areas of green. i.e. every LAU will have the same target according to the area of their administrative area.

Table VIII-1 Summary table screened target options for urban ecosystem restoration

Target option	Screened in/out for assessment	Key reason(s) for screening in/out
Option 1 *** **No net soil sealing in cities towns and suburbs by 2030:** any new soil sealing must be compensated for by an equal area of green land-recycling (i.e. the development of green urban areas using previously built-up or brownfield areas); and **2:1 ratio for 'green land recycling: soil sealing' in cities towns and suburbs achieved in 2050:** all new soil sealing must be compensated with double the area of green land-recycling	Built-up areas have been mainly enlarged at the expense of agricultural land. Progressive soil sealing will take place especially for Western Europe where the area of built-up land increases at a faster rate than the population. Spatial planning strategies determine to a great extent the progression of soil sealing. Unfortunately, neither the economical nor the ecological or the social effects of irreplaceable soil losses have been considered adequately so far. A rational land-use planning to enable the sustainable management of soil resources and the limiting of sealing of open space is needed. Possible measures include the redevelopment of brownfield sites, of vacant and derelict land, and the rehabilitation of old buildings.	Screened out: European cities have sealed, on average, 22 % of their soil but this increases to 58 % if only soil sealing in artificial areas is considered. Land recycling is considered a response to land take within urban areas, i.e. urban development on arable land, permanent crop land or semi-natural areas. It is a key planning instrument for achieving the goal of no net land take by 2050 (EC, 2016) and could be key to improving land management and maintaining and developing the green infrastructure that is so important for the provision of ecosystem services. However, a target on soil sealing only in functional urban areas is considered too blunt a tool for meeting the aim of improving the quality of urban ecosystems, and in turn the overall aims of the EU Biodiversity Strategy. Different cities are at different stages of growth/development, and each may have very different, highly complex landscapes, needs, surrounding ecosystems, as well as different availabilities of land for recycling. In reality the environmental impact of urban developments can vary

		greatly – so to ensure the overall quality of urban ecosystems improves, it is more appropriate to set a target directly on this (giving Member States the flexibility to implement this, while still meeting other urban developmental needs.) In other words, accepting that growth may be inevitable, but ensuring that it is implemented thoughtfully, respecting good ecological principles as far as possible, and is part of a wider plan to ensure protection and enhancement of urban ecosystems.
Option 2: **No net loss of green urban space by 2030, compared to 2021, within each LAU containing cities, towns and suburbs.** **A national average increase in the area represented by green urban space cover across LAUs containing cities, towns and suburbs, of at least 3% of the total area of these LAUs by 2040 and at least 5% of the total area of these LAUs by 2050, compared to 2021.**	Urban Green and Blue Infrastructure will be capable of generating a substantial range of social, environmental and economic benefits for urban citizens, whilst also providing protection against the effects of climate change. Key components are the promotion of: multifunctional design (where a range of benefits are provided in one area through careful planning, integrated design and management) to deliver these benefits. a) Ecosystem-based management modes b) Intersectoral planning This target will measure the proportion of existing green and blue infrastructure, with indicators that build on quality of ecological values and climate change adaptation and mitigation potential.	Screened in: Urban green in almost all forms provides a wide range of very clear, well defined, relatively low-cost benefits, not least protecting and enhancing biodiversity, supporting pollinators, protecting from the negative impacts of climate change and supporting the mental and physical well-being of citizens. However due to pressure for land in developing and growing cities often urban green is being lost unnecessarily, rather than preserved and enhanced. Overall levels should be protected and increased modestly over time, restoring and enhancing the quality of these important ecosystems. This option does not imply a restriction on urban development set at this level, (that is not the remit of this initiative) it rather means new developments should be encouraged to be nature-enhancing, land should be recycled when possible and/or compensated for if necessary. The IA has shown that this is a feasible option that, if the benefits of urban green are accounted for correctly, will actually also save costs in the medium term. It is implemented already in many cities.
Option 3: no net loss of tree canopy cover by 2030, compared to 2021, within each LAU	Trees and other woody plants along streets and in public squares and car parks as well as private gardens can contribute to biodiversity, climate	Screened in: This options fits well with option 2 on protecting and enhancing relative levels of urban green. (Tree cover is obviously a

containing cities, towns and suburbs.. **a minimum of 10% tree canopy cover in each LAU containing cities, towns and suburbs by 2050.**	change mitigation and adaptation, for example by reducing urban air temperature and therefore the urban heat island effect through evapotranspiration and by providing shade, the mitigation of extreme weather events, such as the reduction of stormwater run-off during heavy rainfall events. Trees can help to clean the air of harmful pollutants and can increase surrounding property values by 2-10 %. Moreover trees contribute to the provision of recreation services and to the suitability of land to support insect pollinators (Zulian et al 2013; Stange et al . 2017) Tree cover is a key and simple element in understanding the magnitude of the urban forest resource and can be used to assess various ecosystem services and values derived from the forest. Average tree cover in European urban areas is 19.6 % (Nowak, 2020), but in many individual city LAUs the area is below 10%.	subset of urban green. Meeting this will impact positively on the other) It aims to ensure that a modest, and achievable minimum level of tree canopy cover over time (and therefore high quality form of urban green) is achieved by 2050 for those most densely populated urban areas (city LAUs) with the fewest tress at the present. This minimum level is such that is will ensure the minimum threshold of tree canopy cover is reached to ensure biodiversity can thrive, and that all cities are equipped to deal with the inevitable impacts of climate change, namely: protection from excessive heat, and reduction in the risks from flooding. The multiple benefits related to mental health and well-being, and helping to deal with filtering polluted air and water should also not be underestimated.

Following from this screening process, Option 1 was rejected. When considering the growth of urban development, it was considered too be blunt a tool for cities to integrate in their planning processes. As the aim of this initiative is to enhance the condition of urban ecosystems, a target based on levels of soil sealing is not considered to be a sufficiently accurate and comprehensive indicator. Soil can be partly sealed while maintaining or enhancing urban ecosystem condition, for example with green roofs, tree lined streets, permeable car parking with trees. In addition, issues related to sprawl and soil sealing may be addressed as part of the developing soil strategy/policy framework.

Options 2 and 3 were selected, but refined to bring together the tree canopy cover with the urban green area target (rather than as an independent target) as follows:

No net loss of green urban space, including tree canopy cover, by 2030, compared to 2021, within each LAU containing cities, towns and suburbs;

A national average increase in the area represented by green urban space, including tree canopy cover, across LAUs containing cities, towns and suburbs, of at least 3% of the total area of these LAUs by 2040 and at least 5% of the total area of these LAUs by 2050, compared to 2021:

A minimum of 10% tree canopy cover in each LAU containing cities, towns and suburbs by 2050

This combined option can be operationalized as an integral part of urban infrastructure independent of the historical developments and geographic location of the city, as the multiple benefits of green infrastructure and in particular trees are increasingly known to urban planners and decision makers and stimulated by initiatives such as the Green City Accord and the Urban Greening Plans part of the ambitions of the EU Biodiversity Strategy for cities above 20,000 inhabitants.

For tree planting, this would need to be done in full respect of ecological principles, for example, prioritizing native tree species and avoiding the use of non-native species.

During the assessment process, it also became clear that any target should promote the greening of any new urban developments, and ensure that no 'rebound effects' could come from the setting up of any targets that might mean the building of new all grey infrastructure on natural land simply being compensated elsewhere. (Compensation may have an important role to play, but it should not be used to make up for low quality new developments degrading natural land). Thus the following requirement was also added:

Ensure a net gain of green urban space is integrated into existing and new buildings and infrastructure developments, including through renovations and renewals, in LAUs containing cities, towns and suburbs.

Below are some of the key figures related to the targets established:

Table VIII-2 *shows the areas needed to meet the respective targets for 2030, 2040 and 2050 for the options considered.*

Table VIII-2: areas needed to meet the respective targets for 2030, 2040 and 2050.

Targets	**Area (km²)**	**Area (% of LAUs)**
Urban green for no-net-loss by 2030:	2,900 km²	
Urban green for 2040 target	26,679 km²	3.00%
Urban green for 2050 target	17,786 km²	2.00%
Total additional urban green	**44,465 km²**	5.00%
Tree cover for no-net-loss by 2030	2,059 km²	
Tree cover for 2040 target	19,176 km²	2.15%
Tree cover for 2050 target	12,784 km²	1.43%
Total additional tree cover	31,959 km²	3.58%
Tree cover for 2050 target of 10% in cities, towns and suburbs*	9,522 km²	1.06%

* The area of tree cover in km² needed in order to meet the 2050 target of 10% will mostly already be met by the increase of 5% tree cover (i.e. most LAUs below 10% are near enough to mass this milestone anyway) so the total tree cover figure does not include the 10% area in addition.

The headline figure here of total urban green by **2050 of 44,456km²**. This is considered to be in line with, or below, the potential land available to meet the targets, especially if looked at over the 2050 time frame.

Considering the areas that have been estimated (and presented earlier in this document) we can see that contributions could be made by:

a) Abandoned land / contaminated artificial surfaced land potential: **9,000 km² (up to 40,000 km² in one study)**

This abandoned artificial surface, however, only represents around 12% of the land surface of the LAUs in question. The rest is made up, around this artificial surface, of natural and semi-natural land and including significant agricultural land. Any tree planting in these areas, around cities or the enhancing of agro-ecosystems with 'landscape features' could also contribute to improving urban ecosystems and to meeting the targets proposed. Total abandoned agricultural land in the EU is as much as 116,410 km², so levels of abandoned land in LAUs classified as city, and town and suburb, could be significant.

b) Renovation of building stock at average rate (over 25 years): **5,000-10,000 km²**

c) Active green restoration: the figures above relates to normal rates of renovation, and then to the levels of abandoned land, however, there is also potential for more actively greening of 'in use' artificial surface that may not fall within the definitions of 'renovations' set out previously - i.e. by going beyond normal renovation rates to undertake more active greening of roofs, car parking areas, tree lining streets etc,. For this type of specific green renovation considerably more land is potentially available. Bastin et all estimate this potential land availability to be more than **30,000km²** (Bastin et al. 2020)

8.4 Impacts of assessed target options

Due to the innate nature and variety found across different European cities, providing simple assessments for the cost and benefits of urban green space and levels of tree cover is not possible: Land values vary by multiple orders of magnitude; pressures for space vary tremendously, as does the age and historical development of cities; access to green space varies widely; existing climate and likely future impact of climate change also vary widely.

However, in spite of this extreme variation, when looking at some of the basic costs and benefits of setting targets for halting the steady degradation of urban ecosystems currently being seen, and then setting feasible and achievable restoration targets for 2030, 2040 and 2050, (i.e. those selected), and targets in line with other commitments (such as for the planting of additional trees in the EU) the costs are seen to be lower than assessed benefits, (see table below for examples of the range of costs / benefits of urban ecosystems and their restoration), and that is even when many of the benefits that are difficult to quantify are not accounted for.

The **costs** of provision of green urban space and increasing tree cover in cities vary widely by location and are influenced by factors such as the density of urban development, the price of land, and the extent of available land for green spaces, trees and woodlands, all of which vary widely between urban locations across the EU. **As a result, it is difficult to identify generalised unit costs that can be applied to assess the overall costs of meeting urban ecosystem restoration targets.**

However, the typical **costs** of meeting urban ecosystem restoration targets include:

- Capital costs of green space provision or restoration. These include construction and site preparation costs (e.g. works required to recycle brownfield land for creation of urban green space) and costs of planting trees, parks, gardens, green roofs and other green infrastructure features. They include costs of labour, machinery, energy, materials, plants/saplings and other inputs.
- Ongoing costs of green infrastructure maintenance. These include costs of managing parks, gardens and green spaces, and maintaining trees and woodlands. They include similar types of inputs as the capital costs of green infrastructure provision.
- Opportunity costs. Where land managed as green space or woodland cannot be developed for other purposes, such as for commercial, residential or infrastructure development, there are opportunity costs in terms of forgone revenues and economic development opportunities. These opportunity costs are reflected in the high price of land in most urban areas, but overall they are enormously variable, (from luxury flats in town centres to out of town parking/storage lots for example) and therefore and estimates are somewhat speculative/generalised.

Administrative and information costs. These include the costs of establishing management bodies, developing and implementing urban green infrastructure plans and strategies, public consultations, conducting surveys and monitoring, and the costs of administering capital works and ongoing maintenance programmes (Naumann et al., 2011) (Tempesta, 2015).

The **benefits** of urban ecosystem restoration include a range of ecosystem services (Haase et al 2014):

- Provisioning services – e.g. provision of food, fibre and fuel through gardens, allotments and community orchards and woodlands;
- Regulating services – e.g. regulation of climate, air quality, water quality and flooding;
- Cultural services – e.g. benefits for recreation, tourism, urban landscape and visual amenity, and resulting impacts on physical and mental health and wellbeing (Naumann et al., 2011).

In turn these ecosystem services deliver broad economic and social benefits, e.g.

- Reduced costs of flooding, water treatment and climate change impacts;
- Reduced costs for morbidity and mortality due to the various health benefits of ecosystem services
- Business benefits, by enhancing the working environment and attracting paying visitors;
- Community benefits, by providing spaces for social interaction, meetings and events;
- Enhanced property prices, with evidence of price premium for developments close to green space;
- Enhanced investment, as an improved urban environment encourages new development, regeneration and business investment;
- Creation of jobs in green infrastructure provision and maintenance (Naumann et al., 2011).

The **benefits of green spaces and urban tree cover vary widely by location**, and are influenced by factors such as:

- The extent, proximity to residential areas and accessibility of existing urban green space (and hence the degree to which this currently provides opportunities for recreation, exposure to green spaces and associated health and wellbeing benefits);
- The climate of urban areas (and hence the benefits of trees and vegetation in cooling and insulation)
- The prevalence of environmental hazards such as flooding (and hence the benefits of reduced run-off)
- The extent and distribution of physical or biological hazards for urban dwellers and ecosystems (i.e. air/water pollutants, noise, pests) and the potential to address these through trees and green infrastructure.

As a result of wide variations in both benefits and costs, the benefit: cost ratios of urban greening vary widely by context. In general, they are highest in places where ecosystem services are constrained (e.g. where access to green space is limited, air quality is poor, a lack of tree cover limits temperature regulation and other problems such as flooding are prevalent) and where the costs of action are lower (where land for planting trees and creating new green spaces is available, inexpensive and not difficult to recycle, and where expensive re-planning and reconstruction can be avoided).

While benefit values vary and are difficult to generalise, **the available evidence suggests strong benefit:cost ratios** in investment in provision of street trees and increasing urban tree cover, which yields benefits for air quality, regulation of climate and visual amenity, as well as for provision and enhancement of green space, enhancing recreational opportunities, health and wellbeing and amenity values. (see details in summary in next section)

There is good evidence that provision of urban green space – including green spaces, natural areas and increased tree cover – delivers a wide range of ecosystem services to citizens and businesses, and that the benefits of protecting, and undertaking modest restoration of urban ecosystems, significantly exceed the costs. At the same time, rapid and significant restoration of urban ecosystems is neither feasible or practical, especially in core cities. **The aim of setting these targets for restoring the urban ecosystem is to slowly but steadily steer urban planning process towards systematically integrating urban ecosystem thinking into their processes** – prioritising *inter alia*:

- development in locations that have the lowest biodiversity/ecosystem value, (i.e. brownfield restoration);
- developments that actually enhance and improve urban ecosystems by fully integrating green infrastructure (green roofs, extensive tree cover, parks and gardens, minimal soil sealing);
- compensating for loss of urban green or tree canopy cover as a last resort.

Quaranta et al[33] show that green roofs could deliver significant benefits to European cities. They estimated that they can cool surfaces by between 2.5° and 6°, causing a reduction of sensible heat to the atmosphere, a driver of urban heat island effects, reducing air temperature of about 50% with respect to the surface temperature reduction.
Urban greening has the potential to reduce urban runoff by about 17.5%, helping reduce urban diffuse pollution and the frequency of combined sewer overflows. As such, the role of green roofs should be considered in the context of river basin management. Other benefits include:

- the reduction of heat flow to buildings, corresponding to a potential cooling energy saving, the effects of carbon dioxide sequestration by biomass growing on green roofs.
- benefits related to runoff reduction and combined sewer overflow mitigation,
- increase of property values, socialization (e.g. related to community gardening) and wellbeing.
- Biodiversity improvement, supporting pollination and improving the environmental quality of urban landscapes.

They point out that due to the fact that urban greening requires for a large part private investments, if it is to be implemented on a large scale on European urban surfaces, appropriate fiscal and funding policies will be needed. They say urban greening could represent a multifunctional no-regret, cost-effective solution meeting the aspirations of the European (and global) sustainability agenda.

This section therefore summarises the range of costs and benefits relating to the targets assessed.

The following information shows the potential benefits and costs related to the options proposed, although the differences across EU Member States with regards to costs of urban development and green infrastructure implementation should be considered.

[33] https://www.nature.com/articles/s41598-021-88141-7

The following benefits, which are based on local examples, give an indication of the large potential that investment in urban greening has.

Summary of Benefits Estimates for urban ecosystem restoration option

Biodiversity:

Tree cover and/or other urban green has a significant and meaningful beneficial impact on biodiversity, particularly if part of a wider green-infrastructure urban greening plan.

Urban green space has a positive impact upon local biodiversity by helping to increase habitat areas and by creating ‘wildlife corridors’ that can make it easier for species to move between individual green spaces. The green spaces found in cities and towns can form a vital habitat for pollinators, such as bees, butterflies and hoverflies. Urban environments can play an important role in helping to build habitat for these species. Urban areas can provide a wide variety of flowering plants and also mostly avoid pesticides that are used in agricultural areas.

A comparison of biodiversity levels between more than a hundred cities worldwide showed that bird and plant species densities vary substantially among cities and were explained best by a city's urban land cover, age of urban area as well as an intact urban vegetation cover (Aronson et al. 2014a). The city-wide vegetation cover is commonly assessed to derive conclusion on a city's species richness or its capacity therefore. Some key relevant findings are that:

Vegetation cover below 10% has been found to cause rapid declines in species richness (Radford *et al*. 2005), and that:

A landscape-level threshold of 20–30% of a specific habitat has to remain to prevent the combined effects of habitat loss and fragmentation to exacerbate the loss of species or populations (Hedblom & Soderstrom 2010).

Aronson *et al*. (20142015) concluded that intact vegetation cover is the strongest explanatory variable for variation in species density among cities worldwide. **The proportion of green surroundings as well as many other biotic habitat categories have a significant positive effect on urban species richness**.

Flood risk reduction:

Increasing tree cover and/or urban green has a very significant and measurable impact on flood prevention.

A 10% increase in green space can reduce run-off in residential areas by 5%, while a 10% increase in tree cover can reduce run-off by 5.7%. Adding green roofs to all urban buildings could reduce run-off by 17-20%;

Vegetated surfaces reduce the volume of surface water runoff by storing and intercepting rainfall. For example, studies have shown that green roofs have the capacity to capture 70% of rainfall during a flood risk period.

Urban trees and forests are now being regarded as important and cost-effective way of reducing flood risks and reducing the impact of rainstorms – studies estimate that for every 5% increase in tree cover area, run-off is reduced by 2%.

Sustainable 'nature-based' urban drainage systems have 50% lower capital costs and 20-25% lower annual maintenance costs than traditional drainage systems, while also providing valuable services to biodiversity.;

Examples of effectiveness of small-scale NBS for flood mitigation (see also Ruangpan et. al., 2020)

- Porous Pavements: Runoff volume reduction ~30–65%; Peak flow reduction ~10% - 30% (Shafique et al., (2018), Damodaram et al., 2010);
- Green Roofs: Runoff volume reduction up to 70%; Peak flow reduction up to 96% (Burszta-Adamiak and Mrowiec (2013), Ercolani et al. (2018), Carpenter and Kaluvakolanu, (2011), Stovin et al. (2012));
- Rain Gardens: Runoff volume reduction up to 100%; Peak flow reduction ~48.5% (Ishimatsu et al. (2017), Goncalves et al. (2018));
- Vegetated Swales: Runoff volume reduction up to 9.60%; Peak flow reduction ~23.56% (Luan et al. (2017), Huang et al. (2014));
- Rainwater Harvesting: Runoff volume reduction ~57.8-78.7%; Peak flow reduction ~8%-10% (Khastagir and Jayasuriya (2010), Damodaram et al. (2010)) ;
- Detention Ponds : Runoff volume reduction up to 55.7%; Peak flow reduction up to 46% (Liew et al. (2012), Damodaram et al. (2010), Goncalves et al. (2018));
- Bioretention: Runoff volume reduction up to 90%; Peak flow reduction up to 41.65% (Luan et al. (2017), Huang et al. (2014), Khan et al., (2013));
- Infiltration Trenches: Runoff volume reduction up to 55.9%; Peak flow reduction up to 53.5% (Huang et al. (2014), Goncalves et al. (2018))
- Quaranta et al (2021): 35% of the EU's urban surface (>26,000 km2) would transpire about 10 km3/year of rainwater, absorbing about 17.5% of water that is now urban runoff, helping reduce water pollution and urban flooding.

Urban heat island effect:

Tree cover and/or other vegetation cover has been demonstrated to have a very marked impact on urban temperatures in the surrounding areas.

Urban Green Infrastructure implementation is recognized as one of the key strategies to mitigate heat impact in cities, since green areas provide the microclimate regulation ecosystem service**. The**

net cooling effect of a young, healthy tree is equivalent to ten average sized air-conditioners operating 20 hours per day (FDA, 2021[34]). Nature can help to reduce the risks associated with heat stress by providing cooling through shade and evapotranspiration. However, a substantial proportion of urban population currently lives in areas with high heat exposure (EEA, 2020; Marando et al., 2022[35]).

> *Examples of studies on the effects of NBS on thermal mitigation (reduction of degrees C) in different European case studies (after GreenInUrbs project and Hiemstra et al., 2017):*
>
> - Israel 2-4°C, with Grass lawn / trees (Shashua-Bar et al., 2006)
> - Portugal 2.5-6°C and up to 9°C, with green areas (Andrade and Vieira 2007)
> - Netherlands 0.6°C and up to 4°C, with green areas (Heusinkveld et al., 2014)
> - Sweden 2-4°C and up to 6°C, with parks (Upmains et al., 1998)
>
> - **EU 27**: up to 2.9°C, and 1.07°C on average (Marando et al., 2022)

Marando et al., (2022): In this EU-wide study, the ecosystem service of microclimate regulation has been assessed in 601 EU-27 cities through a model which simulates the temperature difference between a baseline and a no-vegetation scenario. It has been shown that European green infrastructure cools the temperature by 1.07°C on average, and that a 10% increase in urban vegetation reduces the temperature by an average of 0.6°C. The temperature regulation is mostly dependent on the amount of vegetation inside a city, as well as by canopy transpiration. Furthermore, in almost 40% of the countries, more than half of the residing population does not benefit from the microclimate regulation service provided by urban vegetation

> Quaranta et al (2021)
>
> 35% of the EU's urban surface (>26,000 km2) would avoid up to 55.8 Mtons/year CO2e, reduce energy demand for cooling buildings by 92 TWh per year, with a net present value (NPV) of more than €364 bn.
>
> It would decrease summer temperature by 2.5–6 °C, with mitigation of the urban heat island effect estimated to have a NPV of €221bn over 40 years.
>
> Horvathova et al (2021)
>
> Urban cooling from street trees in Prague, Czech Republic: present value of benefits €4362 - 9163 per hectare; benefits exceed costs after 30 years at 3% discount rate.

[34] https://www.fs.usda.gov/detail/r9/home/?cid=STELPRD3832558

[35] Healthy environment, healthy lives: How the environment influences health and well-being in Europe EEA Report No 21/2019

Venter et al (2019)

Oslo, Norway: Cooling effects of urban trees - If each city tree was replaced by the most common non-tree cover in its neighbourhood, the area of Oslo exceeding a 30°C health risk threshold during the summer would increase from 23 to 29%. Each tree in the city currently mitigates additional heat exposure of one heat sensitive person by one day.

Marando et al., (2019) Rome, Italy: it has been shown that a large peri-urban forest, an urban forest, and a tree lined road reduce summer temperatures by 2.8 °C, 3 °C and 1.3°C, respectively. Furthermore, the cooling effect extends by an average distance equal to 170, 100 and 30 meters, respectively.

Climate mitigation:

Urban trees can play an important role in climate mitigation

A mature urban tree is capable to absorb around 90 kg of carbon per year, and as a consequence contribute to mitigate climate change (McPherson et al (1994)**.**

The tree canopy cover targets (taking a conservative estimate of 1,500 trees per hectare) represent around 300 million trees in towns, cities and suburbs by 2030 (so more than 10% of the EU wide 3 billion tree target) and a total of nearly 4.8 billion by 2050 , distributed over more that 32 million hectares of land. This would represent a significant step towards the climate mitigation objectives.

Studies have also demonstrated clearly that green roofs and walls can make buildings significantly warmer in winter (up to 4.5°C), as well as and cooler in summer, which represents significant energy savings for heating and cooling

Health and well-being:

Urban trees and green and blue spaces provide multiple benefits for mental health and well-being, for recreation, as well as the ability to reduce levels of pollution significantly.

European residents of areas with the most greenery were 3 times as likely to be physically active and 40% less likely to be overweight or obese, than those living in the least green settings. People are happier when living in urban areas with large amounts of greenspaces, showing lower mental distress levels and higher wellbeing (life satisfaction) levels.

Living in or close to green areas can reduce mental stress and increase life satisfaction. Pregnant women living more than 300 meters away from green spaces have higher blood pressure compared to those who live closer.

Kwon et al (2021)

90 global cities in 60 developed countries, covering 179,168 km² and 230 million people: Correlation between urban green space (UGS, based on high-resolution satellite imagery), happiness and GDP. Urban green space and GDP are correlated with a nation's happiness level. Strongest correlation between UGS and happiness is in wealthiest countries.

Vivid Economics (2017) Green space in London, UK   Recreation, mental and physical health, residential property, carbon and temperature: Gross capital value of benefits of £91.3 bn (€107bn), with largest values for residential property (61%), recreation (19%), physical health (12%) and mental health (7%). Each £1 spent on public parks delivers £27 in benefits to Londoners.

WHO Regional Office for Europe (2016)

Urban green spaces, such as parks, playgrounds, and residential greenery, can promote mental and physical health, and reduce morbidity and mortality in urban residents by providing psychological relaxation and stress alleviation, stimulating social cohesion, supporting physical activity, and reducing exposure to air pollutants, noise and excessive heat.

European Environment Agency briefing (2022) 'Access to nature in European cities': *Parks, urban forests, tree-lined streets and riverbanks support urban well-being by providing space for rest, relaxation and exercise and keeping temperatures down. But not everyone across Europe enjoys equal access to green spaces in cities.* This briefing reviews the evidence of socio-economic and demographic inequalities in access to the health benefits derived from urban green and blue spaces across Europe.

Pollution of air and water:

Green infrastructure has also been shown to help improve the quality of air and water and can reduce the volume of pollutants entering water courses.

Trees and vegetation are able to intercept large volumes of rain through their canopies and roots, which reduces urban flood risk, and in **addition particulate levels on tree-lined streets can be up to 60% lower than those without trees**. In a study carried out in 10 Italian metropolitan cities (Manes et al. 2016), it has been shown that urban and peri-urban forests exert a remarkable role in ameliorating urban air quality, removing an amount of some air pollutant (tropospheric Ozone and particulate matter) equal to 37,164 tons in one year, with a relative monetary benefit (due to avoided impacts to human health, ecosystems and materials) equal to 344 million USD/year.

Examples of cases reported at the NWRM platform:

Permeable surfaces, Swales, Filter Strips, Detention Basins and Retention Ponds Oslo, Norway[36]: Increase in water storage 230 m3/ha: o 60 % reduction pollution Phosphorus (P) o 40 % reduction pollution Nitrogen (N) o 80% reduction Total Suspended Solid (TSS) o 65 % reduction pollution Copper (Cu) o 45 % reduction pollution Zinc (Zn)

Permeable surfaces, Swales, Filter Strips, Soakaways Detention Basins, Retention Ponds, and Infiltration basins, Utrecht, Netherlands[37]: • Retained water 2,200,000 m3/year • Increase water storage 1,000 m3/ha • 80 % reduction pollution Phosphorus (P) • 50% reduction Total Suspended Solid (TSS) • Potential for recreational activities in the water courses that will be created

Noise control: Grass surfacing reduces noise by up to **3 decibels** compared to concrete paving, while planting vegetation 10 metres wide can reduce noise from traffic and other sources by 3-8 decibels, more effectively than man made barriers.

Property value: This benefit varies widely, but is often discussed. Various assessments show that **residential property can increase in value due to the proximity to green space, by up to 15-25%.** Properties on tree-lined streets have been shown in some multi-city studies to be valued on average at up to 30% more than those on streets without trees.

Further case study examples of benefits exceeding costs for urban trees and green spaces

Greening 35% of the EU's urban surface would generate net benefits worth €364 bn through reduced cost of cooling and €221bn through reduced urban heat island effect, as well as absorbing 17.5% of urban run-off (Quaranta et al., 2021). Benefits of planting and maintaining urban street trees in Prague, Czechia, exceed the costs over 30 years, in terms of cooling alone, even before other benefits for climate, air quality and biodiversity are considered (Horvathova et al, 2021) Benefits of urban street trees in California, US, are 5.8x costs (McPherson et al., 2015, 2016) Benefits of urban street trees in New York, US, are 5.5x costs (Peper et al., 2007)

[36] http://nwrm.eu/case-study/sustainable-stormwater-management-and-green-infrastructure-fornebu-norway
[37] http://nwrm.eu/case-study/leidsche-rijn-sustainable-urban-development-netherlands

Each £1 spent on public parks in London, UK, delivers £27 in benefits through recreation, mental and physical health, residential property, carbon and temperature regulation (Vivid Economics (2017)

Investment of £5.5 billion in the UK would deliver £200 billion in physical health and wellbeing benefits for disadvantaged communities, a benefit: cost ratio of 36 in terms of health benefits alone. It would create 40,000 temporary jobs in construction and 6,300 ongoing jobs in maintenance, and benefit active travel, biodiversity, carbon capture and air quality (Vivid Economics and Barton Wilmore, 2020).

Sustainable urban drainage systems have 50% lower capital costs and 20-25% lower annual maintenance costs than traditional drainage systems (SNH, 2014).

According to the 2030 BiodiverCities report (Jan 2022), by 2030 **nearly half (44%) of the GDP of cities will be at risk due to the loss of biodiversity**. They say that to avoid an economic collapse, nature-based solutions are needed. The report says that spending €520 billion on developing green infrastructure, along with related actions aimed at freeing up land, could create 59 million jobs, including 21 million dedicated to the restoration and protection of ecosystems. According to the report, nature-based solutions are not only better for the climate and biodiversity (with an **average value-added of 28%**) but they are also more efficient from an economic point of view compared to conventional engineering solutions (by **50% on average**).

8.5 Synthesis

Table VIII-3: Overview table assessing options on EU impact assessment criteria urban ecosystems

	Option 1	Option 2	Option 3	Conclusions
Feasibility / effectiveness	Likely to be effective in some respects to halt urban sprawl, prevent soil sealing and in turn protect semi-natural and forest areas in and around urban spaces. Would not encourage the greening of existing and new buildings stock or other infrastructure. Could encourage the building of permeable car parking.	Feasibile and effective action for restoration. Increasing green infrastructure (GI) can contribute to biodiversity and other ecosystem services, as well as improved ecological connectivity between urban and peri-urban areas. Important and effective for adapting to the impacts of of climate change – a specified	This option has partly been merged with option 2. Proportionate targets for tree canopy cover are considered feasible. The 10% minimum tree cover by 2050 for all city, towns and suburbs LAUs is considered as both feasible and effective as a minimum level to which all LAUs with high density of population should	Integration of urban green space components in existing urban structures and increasing space for nature and tree cover, considering ecological principles, will create a resilient and networked "city ecosystem" capable of generating a substantial range of social, environmental and economic benefits for urban

	In terms of feasibility, this option could have social and economic costs (preventing certain types of urban development) that lie outside the specified objectives of this nature restoration proposal.	objective of the biodiversity strategy nature restoration plan.	reach to ensure at least some support for biodiversity and climate change adaptation objectives.	citizens, whilst also providing protection against the effects of climate change. In terms of feasibility, the options selected are in line with the availability of brownfield land, the turnover and ‘greening’ renovation of building stock, and the restoration and enhancing of abandoned agricultural land around urban centres.
Efficiency	This measure is not considered an efficient option for meeting the objectives of the biodiversity strategy as it would have too many additional implications for how and where urban development would take place (rather than focusing on urban ‘greening’)	Many cities are relatively green but can benefit from increased efforts in improving the quality of existing public green spaces restoring ecological functions and ecosystem services benefits.	The structure, in terms of the number, density, sizes and species composition, health and spatial configuration of street trees, largely determines the benefits. This requires good growing conditions for new and existing trees and to ensure diversity of native tree species composition.	Increasing urban green and blue infrastructure, including tree cover, are realistic targets for most cities, with emphasis on public green spaces, ensuring accessibility for all citizens and embedding them in existing and new urban development plans, which has proved effective as more and more European cities are developing urban green infrastructure strategies and integrate nature in their master planning. Options 2 and 3 offer a very efficient way to deliver multiple services for biodiversity, climate change mitigation and adaptation, air and water filtration (contributing to the meeting of waste water treatment objectives by reducing flood water) as well as supporting

				the commitment to plant 3 billion trees
Coherence	Coherent with the European Commission's Roadmap to a Resource Efficient Europe aims for a 'no net land take by 2050'. This means that land recycling and densification rates must show an increasing trend, which would result in a direct contribution to reducing net land take.	Full coherence with EU environmental policies and climate goals. Potential to make substantial contributions to climate adaptation and mitigation, as well as health and wellbeing objectives, Also supports, SDGs, adaptation strategy, sustainable city policy.	Full coherence with EU environmental policies and climate goals. As part of the EU Climate Pact, the EU is further pledging support to local communities, organisations and citizens who are committed to new tree-planting initiatives. Full coherence with SDG (15 and 11).	Options 2 and 3 have multiple links to, and positive impacts on, a wide range of EU and international commitments and policies.
Proportionality	Built-up areas have been mainly enlarged at the expense of agricultural land. Progressive soil sealing will take place in urban areas considering the urban growth trends, however this option is considered disproportionate in terms of delivering urban ecosystem objectives.	Proportionate and in line with the importance of improving biodiversity and associated ecosystem services and reducing the harmful impacts of urbanisation and habitat fragmentation across Europe as well as restoring the connection between people and nature. Given the widespread benefits seen in terms of urban cooling, flood protection and physical and mental well-being, combined with enhancing biodiversity protection this option is considered proportionate given the achievable level of target and time frame proposed.	See option 2 + the pattern of decreasing tree cover and leading to loss of environmental benefits and increased environmental issues of this very valuable form of urban green.	Even small areas of vegetation can have a positive impact upon biodiversity, and urban biodiversity needs to be managed by considering the functions of tree and plant species and their role in delivering key ecosystem services.

It is proposed that 2021 will serve as a practical reference starting year, with the setting of goals for both 2030, 2040 and 2050.

For all the options, Copernicus data are already fully available for setting and monitoring these targets for all LAUs. The Copernicus Land Monitoring Service provides geographical information on land cover and its changes, land use, vegetation state, water cycle and Earth's surface energy variables to a broad range of users in Europe and across the World in the field of environmental terrestrial applications.

Conclusions

Table VIII-4: Summary

Issue	Details / best estimates
Tree cover and/or other urban green has a significant and meaningful beneficial impact on ***biodiversity****, particularly if part of a wider green-infrastructure urban greening plan.*	Minimum threshold estimate 10-30% green cover
Increasing tree cover and/or urban green has a very significant and measurable impact on ***flood prevention****.*	5% increase in green cover: 2-2.5% runoff reduction. *(multiple studies)* NBS 50% lower capital cost + 20-25% lower maintenance
Tree cover and/or other vegetation cover has been demonstrated to have a very marked impact on ***urban temperatures*** *in the surrounding areas.*	10% increase in urban vegetation: temperature reduction ~ 0.6°C *(multiple studies)*
Urban trees can play an important role in ***climate mitigation***	One tree: 90kgs CO^2 per year. Cooling in summer and heat retention in winter can have important energy benefits/
Urban trees and green and blue spaces provide multiple benefits for ***mental health and well-being****, for recreation.*	Strong evidence from multiple studies linking health and well-being to levels of, and proximity to, green space in urban settings. Mostly not quantified in monetary terms. One study puts ratio of cost to benefits of public parks at 1:27
Green infrastructure has also been shown to help improve the ***quality of air and water*** *and can* ***reduce the volume of pollutants*** *entering water courses.*	Particulate levels on tree-lined streets can be up to 60% lower than those without trees. Permeable surfaces / natural water retention: 50-80% reduction in pollution to rivers.
Significant ***noise reduction*** *from vegetated surfaces*	3-8 decibels locally

The levels of targets proposed have been selected so as to be realistic, and achievable within the bounds of existing urban planning process. They are not only fully in line with EU and international objectives, but they will also do not need to be restricting for urban development, but rather help with steering it to be greener progressively over time. In relation to overall levels of urban green space, starting with 'no net-loss' but giving until 2030 to achieve this basic, common-sense, target will allow for some flexibility in approach. It should be borne in mind that urban development can be 'green' and can enhance the local environment if undertaken with due attention of urban ecosystem condition, such as by using, green roofs, permeable 'green' parking lots, focused tree/hedge planting and incorporation of biodiversity supporting features. Alternatively, or additionally, brownfield/abandoned sites can also be restored elsewhere in compensation. This impact assessment has shown there is potential for such land to significantly contribute to the targets proposed. Thus no-net loss of urban green is considered as a realistic and simple baseline for protecting, and later restoring, urban ecosystems. Having this target will provide a focus for urban planning process, steering them to help achieve the objectives of the biodiversity strategy.

The idea of the targets, and the levels to which they are set is to ensure that the amounts of green space and tree coverage become an integral part of the urban planning process, and that the reach good levels in terms of providing healthy urban ecosystems, by 2050. They can be achieved by restoring degraded and industrial land, greening new developments over time as they are built or replaced (i.e. industrial buildings, housing, retail, local authority builds including hospitals and schools) using options such as tree planting, (including tree-lining streets) green roofs, new green spaces, as well as other "multifunctional" green infrastructure, such as new green mobility lanes or by creation of new parks and woodlands in urban fringes.

In terms of the tree canopy cover targets these are considered as an important sub-set of urban green overall, (so the same arguments apply), but with a very high biodiversity and climate mitigation and adaptation value. It is vital that any urban greening targets ensure the provision, protection and increasing of tree canopy cover in EU urban ecosystems. There is significant capacity within all LAUs for the provision of some increase in tree canopy cover, so the aim of this target is to start moving in the right direction, in line with the planting of 3 billion trees commitment made under the Green Deal. The target for an absolute minimum of 10% tree canopy cover in the LAUs will help to ensure a minimum level of urban ecosystem restoration is undertaken, and support key climate change mitigation and adaptation objectives, in turn supporting air and water pollution objectives.

For 2050 achievable increases in the targets have been proposed that continue the restoration at a similar pace post 2030 and 2040, but over the following decades. Again, they have been set at a relatively low levels per year, to stimulate better urban planning processes, rather than to restrict growth / development.

Overall, there is good evidence related to the costs and benefits of increasing urban green space, albeit almost all in case study form. These demonstrate convincingly a wide range of positive benefits coming from increasing and maintaining higher levels of urban green space. Due to the wide variation, however, in many aspects of the studies, such as the (climate/locations/type of urban space), and the (often limited) parameters being investigated (pollution, energy, water runoff, health and well-being, climate mitigation etc) it is not possible to monetize some of these benefits in a generalized manner. Indeed, the high number of multiple co-benefits provided by using nature-based solutions to urban challenges tends to mean often the full benefits of urban green space and tree cover are underestimated. So, while it has not been possible to undertake a traditional cost/benefit analysis, as can be done on single issues, evidence points to the clear net positive values of halting the loss of, and then restoring green urban spaces.

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Data used for the calculations:

GEOSTAT 1km² population grid: https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/population-distribution-demography/geostat

Degree of Urbanisation: https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/population-distribution-demography/degurba

GHS Settlement Model grid: settlement layers generated by porting in the GHSL framework the degree of urbanisation model adopted by EUROSTAT that combines the population and built-up grids in each four epochs.

Dataset: Pesaresi, Martino; Florczyk, Aneta; Schiavina, Marcello; Melchiorri, Michele; Maffenini, Luca (2019): GHS settlement grid, updated and refined REGIO model 2014 in application to GHS-BUILT R2018A and GHS-POP R2019A, multitemporal (1975-1990-2000-2015), R2019A. European Commission, Joint Research Centre (JRC) DOI: 10.2905/42E8BE89-54FF-464E-BE7B-BF9E64DA5218 PID: http://data.europa.eu/89h/42e8be89-54ff-464e-be7b-bf9e64da5218

Concept & Methodology:

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9. Soils

Given that the new "*EU Soil Strategy for 2030 - Reaping the benefits of healthy soils for people, food, nature and climate*" COM/2021/699 final, published in November 2021 is announcing a dedicated legislative proposal on soil health by 2023, no overarching soil target is being proposed in the nature restoration law but one of the target options from this chapter (Rewetting drained organic soils) is being retained and integrated in the Commission proposal under the agro-ecosystem targets because of its high importance for nature and biodiversity as well as its high urgency.

6.1 Scope

Soils are generally referred to as being mineral or organic. **Organic soil** has in general a 40cm or thicker surface layer of organic material and 20 % or more soil organic carbon (SOC) %[38]. **Mineral soils** are all other soils that do not satisfy these criteria.

Soil organic matter (SOM) refers to all the organic components of soil in different stages of breakdown including living plants and animals and dead organic matter. SOM is essential for soil ecosystem processes - water storage, nutrient cycling, soil fertility and pollutant filtering - linked to soil structure and soil health, crop productivity, soil structure, drought resilience, reduced erosion risk.

Soil organic carbon (SOC) as the measurable component of SOM is one of the main indicators of soil health. SOC has crucial role for climate change mitigation - EU soils hold around 75 billion tons of carbon, more than in vegetation and air combined[39]. Most SOC stocks are in organic soils in Northern Europe[40]. Lowest concentrations are around the Mediterranean, parts of France, Germany, and some eastern European countries[41]. SOC content is highest in wetland soils, followed by forest & grassland soils, with lowest SOC content in cropland and sparsely vegetated areas.

6.2 Problem, current trends and ecosystem-specific baseline

Soil restoration is urgently needed as soils provide the main foundation for life on Earth, both above and below ground, yet soil condition is deteriorating in the EU where around 60-70% of soils are estimated to be unhealthy. SOC is a key indicator for soil health as it plays a crucial role in soil biological, chemical and physical processes which underline the delivery of all soil

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[38] Based on the World Reference Base definition of Histosols (see main fiche for full definition).

[39] Gobin, A., Campling, P., Janssen, L., Desmet, N., van Delden, H., Hurkens, J., Lavelle, P., Berman, S. (2011). Soil organic matter management across the EU – best practices, constraints and trade-offs, Final Report for the European Commission's DG Environment, September 2011.

[40] Schils, R, Kuikman, P, Liski, J, Van Oijen, M, Smith, P, Webb, J, Alm, J, Somogyi, Z, Van der Akker, J, Billett, M, Emmett, B, Evans, C, Lindner, M, Palosuo, T, Bellamy, P, Jandl, R and Hiederer, R (2008) Review of Existing Information on the Interrelations between Soil and Climate Change (CLIMSOIL final report). Contract number 070307/2007/486157/SER/B1, European Commission, Brussels.

[41] de Brogniez, D., Ballabio, C., Stevens, A., Jones, R.J.A., Montanarella, L. and van Wesemael, B. (2015), A map of the topsoil organic carbon content of Europe generated by a generalized additive model. Eur J Soil Sci, 66: 121-134. https://doi.org/10.1111/ejss.12193.

ecosystem services including carbon sequestration, soil fertility, and hazard risk mitigation. A range of pressures threaten both organic and mineral soils driving their SOC below critically low levels, including land management choices/changes, reclamation and drainage of organic soils, soil erosion, peat extraction, soil sealing, and climate change.

Mineral soils: Around 45 % of EU mineral soils have low or very low SOC and 1.5 % have extremely low SOC levels with lowest levels in Southern Europe[42] and arable soils[43,44,45]. Overall, EU SOC stocks in mineral soils have not changed significantly in the past decade, due to limited land cover change and plateauing of stocks towards a carbon input-output equilibrium that is below optimal levels. Despite this aggregate trend, key regional hotspots are experiencing notable SOC decreases in the Mediterranean and central-eastern Europe. Most areas at risk of critically low and decreasing SOC are on arable land, with decreases of 2.5 % in SOC concentrations reported in cropland from 2009-2015. Grasslands likely have an overall stable or slightly increasing SOC stocks. Trends in forest soil stocks are uncertain but generally acting as a sink. The largest SOC declines from 2009-2015, of 11 % on average, were reported for areas converted from grassland to cropland.

Organic soils: Organic soils, mostly former peatlands drained for agriculture, forestry and peat extraction are a particularly important source of greenhouse gas emissions. An estimated 45 000 – 55 000 km² of organic soil have been drained for agricultural use and are currently losing disproportionate volumes of carbon[46]. Those soils, an estimated 3% of all EU agricultural land, are responsible for about 25% of agricultural greenhouse gas emissions[47]. In the EU, drained peatlands emit around 220 Mt CO_2 every year[48], making the EU the third largest emitter from peatland (behind Indonesia and Russia) worldwide[49]. Within the EU, Germany is the biggest emitter, responsible for 47 Mt CO_2e[50].

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[42] Jones, A, Panagos, P, Barcelo, S, Bouraoui, F, Bosco, C, Dewitte, O, Gardi, C, Erhard, M, Hervás, J, Hiederer, R, Jeffery, S, Lükewille, A, Marno, L, Montanarella, L, Olazábal, C, Petersen, J-E, Penizek, V, Strassburger, T, Tóth, G, Van Den Eeckhaut, M, Van Liedekerke, M, Verheijen, F, Viestova, E and Yigini, Y (2012) The State of Soil in Europe. A contribution of the JRC to the European Environment Agency's Environment State and Outlook Report - SOER 2010, Publications Office of the European Union, Luxembourg.

[43] Costantini, E., Antichi, D., Almagro, M., Hedlund, K., Sarno, G. and Virto, I., 2020. Local adaptation strategies to increase or maintain soil organic carbon content under arable farming in Europe: Inspirational ideas for setting operational groups within the European innovation partnership. Journal of Rural Studies, 79, pp.102-115.

[44] Maes et al (2020) Mapping and Assessment of Ecosystems and their Services: An EU wide ecosystem assessment in support of the EU biodiversity strategy. EUR 30161 EN, European Commission, Brussels.

[45] Jones, A, et al (2012) The State of Soil in Europe.

[46] Tanneberger, F, Tegetmeyer, C., Busse, S., Barthelmes, A. and 55 others (2017) The peatland map of Europe. Mires and Peat No 19 (22), 1-17. (Online: http://www.mires-and-peat.net/pages/volumes/map19/map1922.php). Schils, R, Kuikman, P, Liski, J, Van Oijen, M, Smith, P, Webb, J, Alm, J, Somogyi, Z, Van der Akker, J, Billett, M, Emmett, B, Evans, C, Lindner, M, Palosuo, T, Bellamy, P, Jandl, R and Hiederer, R (2008) Review of Existing Information on the Interrelations between Soil and Climate Change (CLIMSOIL final report). Contract number 070307/2007/486157/SER/B1, European Commission, Brussels.

[47] O'Brolchain, Niall & Peters, Jan & Tanneberger, Franziska. (2020). CAP Policy Brief Peatlands in the new European Union Version 4.8.

[48] Tanneberger, F, Appulo, L, Ewert, S, Lakner, S, Ó Brolcháin, N, Peters, J and Wichtmann, W (2021) The power of nature-based solutions: how peatlands can help us to achieve key EU sustainability objectives. *Advanced Sustainable Systems* No 5 (1).

[49] Joosten, H and Clarke, D (2009) *The global peatland CO2 picture. Peatland status and drainage related emissions in all countries of the world*. Wetlands International. https://www.wetlands.org/publications/the-global-peatland-co2-picture/

[50] UBA (2019) Submission under the United Nations Framework Convention on Climate Change and the Kyoto Protocol 2019. National Inventory Report for the German Greenhouse Gas Inventory 1990–2017, German Environment Agency, Dessau, 945 pp.

In this assessment, organic soils meeting the definition given above are referred to as peatlands, even if they are under agricultural use as grassland or cropland. The scope is therefore wider than the Annex I peatland habitats referred to in the EU Habitats Directive.

The pressures on peat soils in the EU are closely linked to drainage. A key pressure on mineral soils in the EU is soil erosion.

Degradation of peatlands from drainage: problems

Besides greenhouse gas emissions, the continued draining of peatlands as well as other changes in their hydrological functioning often in combination with conversion from wetland to pasture or pasture to cropland, managed burning and over-grazing, afforestation and/or intensified forestry practices have led to different degrees of ecological degradation, impacting all kinds of wetland habitat types and species. Consequently, most mire-related habitat types in the EU are on the red list[51] and are in unfavourable conservation status[52]. The number of characteristic fauna and flora species of these habitats in that red list is high and accounts for a major part of the total biodiversity loss in the EU.

Degraded peatlands cause also other environmental problems as they lose their capacity to control floods by storing water, their capacity to clean water. The risks of peatland fires and soil erosion, subsidence, and landslides increase as peatlands dry out. **Soil erosion:** SOC loss and soil erosion are tightly linked and should be addressed together. 24 % of EU area is threatened by unsustainable erosion (over 2 t/ha/year) and 5.2 % is exposed to severe erosion (over 10 t/ha/year). Arable land has the highest mean soil erosion rate (2.67 t/ha/year), and 6.6 % of EU agricultural area (7.2 % of cropland and 4.5 % of grasslands) is affected by moderate to severe water erosion. Soil erosion is highest in the Mediterranean region: Italy, Spain, Greece, Cyprus and Slovenia.

Baseline scenario: In the absence of additional legally binding soil restoration targets, the current mineral and organic soil degradation trends in the EU are assumed to continue to 2030:

- Mineral soils will continue experiencing low SOC levels on 45% of EU area. Stable trends in aggregate SOC levels are expected to 2030 with some differences across regions and land-uses. Arable land will continue experiencing critically low SOC on a considerable proportion of its area (2.6%) with regional hotspots and, despite a likely overall equilibrium between SOC gains and losses, important declines will continue in high-risk arable areas. Permanent grasslands will likely continue experiencing modest increases in SOC. Forests will continue acting as a sink.
- All currently degraded (drained) organic soils will continue to lose carbon to 2030 and there will be no further significant drainage of undrained organic soils.

[51]Janssen, J A M, Rodwell, J S, García Criado, M, Gubbay, S, Haynes, T, Nieto, A, Sanders, N, Landucci, F, Loidi, J, Ssymank, A, Tahvanainen, T, Valderrabano, M, Acosta, A T R, Aronsson, M, Arts, G, Attorre, F, Bergmeier, E, Bjlsma, R-J, Bioret, F, Bita-Nicolae, C, Biurrun, I, Calix, M, Capelo, J, Čarni, A, Chytry, M, Dengler, J, Dimopoulos, P, Essl, F, Gardfjell, H, Gigante, D, Giusso del Galdo, G, Hájek, M, Jansen, F, Jansen, J, Kapfer, J, Mickolajczak, A, Molina, J A, Molnár, Z, Paternoster, D, Piernik, A, Poulin, B, Renaux, B, Schaminée, J H J, Šumberová, K, Toivonen, H, Tonteri, T, Tsiripidis, I, Tzonev, R and Valachovič, M (2016) European Red List of Habitats. Part 2. Terrestrial and freshwater habitats. European Commission, Luxembourg: Publications Office of the European Union.

[52] EEA (2020) State of Nature in the EU: Results from reporting under the nature directives 2013-2018. EEA Report No 10/2020, European Environment Agency, Copenhagen.

- Current trends of soil erosion will continue until 2030 (decrease of 0.4 % in soil erosion rate).

There is uncertainty around this baseline due to unpredictable impacts from climate change, shifts in the political landscape and increased demand for bio-resources. Changes in the next 2023-2027 CAP funding period might improve SOC management, but this will ultimately depend on implementation at the Member State level. SOC trends under climate change are challenging to predict, but declines are expected at least in some southern regions and in cropland.

The largest potential for SOC stock improvement is on degraded agricultural land as these areas are not saturated for SOC. For managed soils under permanent grassland, forestry, and for all organic soils, the main goal is to maintain current SOC stocks and reverse losses. Many of the measures needed to enhance SOC can also decrease erosion risk and vice-versa. Addressing soil erosion therefore helps maintain and improve SOC levels.

6.3 Target options screened in/out

Proposed overarching target: *Improve SOC in soils under all land uses and reverse current losses on agricultural mineral soil, towards an annual growth rate of 0.4 % in EU soil carbon stocks.*

On all organic soils the aim is to preserve the high carbon stocks and to halt current losses. On mineral soils the aim is to maintain or improve carbon stocks under land uses where SOC is generally accumulating (permanent grasslands, forests and other semi-natural ecosystems), and to enhance stocks under arable land and permanent cropland with critically low and decreasing SOC stocks at a set annual growth rate.

The goal of a 0.4% annual growth rates follows the proposed 4 per 1000 initiative presented at COP 21 which the EU is expected to join as announced under the new EU Soil Strategy. This is the rate of additional soil carbon storage needed to compensate for emissions and keep global warming under 2ºC. Organic soils are excluded from the quantitative target as there are uncertainties around their additional storage potential. The stronger focus on agricultural land is because currently available data shows it has the greatest SOC stock increase potential and low SOC risk, especially in the southern regions of Europe.

Four **complementary options** to reaching this target were identified:

Option 1: ***Restoring and rewetting drained organic soils (drained peatlands) under agricultural use (both grassland and cropland) which are currently losing carbon (appr. 52 000km²).***

Rewetting to different degrees and with different subsequent land uses and management, is the most effective method to stop greenhouse gas emissions from agricultural land, to avoid future loss of SOC stocks on organic soils and to stop and reverse biodiversity loss, in particular as concerns wetland habitats and their species. This option proposes the gradual rewetting of drained organic soil (drained peatland) area under cropland or grassland which is currently losing carbon (52 000 km², less than 1% of EU land) with milestones by 2030, 2040 and 2050. It refers to restoration measures that would most typically include measures such as conversion from cropland to permanent grassland, raising of the water-table, fallowing and extensive grazing and it refers also in particular to rewetting, which is understood as full rewetting in the meaning of 'wet' in the water table depth classes based on IPCC (2014): 'dry'= deep drained = mean annual water table lower than 30 cm below soil surface, 'moist' = shallow-drained = mean annual water table at ~30 cm below soil surface, 'wet'= undrained/rewetted = mean annual water table at the soil surface. The wording of the target suggested is as follows:

For drained peatlands under agricultural use, Member States shall put in place, without delay, restoration measures, including rewetting, on at least:

a) 30% of such areas by 2030 of which at least a quarter is rewetted

b) 50% of such areas by 2040 of which at least half is rewetted, and

c) 70% of such areas by 2050 of which at least half is rewetted.

Restoring and rewetting drained peatlands under agricultural use will affect Member States to different degrees (see Table IX-1). The Member States by far the most affected in proportional terms are Netherlands and Finland where organic soils constitute more than 10% of their agricultural land followed by Germany, Ireland, Latvia and Estonia. In terms of absolute surface Germany and Poland are the MS with the biggest areas of organic soils followed by the Netherlands, Ireland and Finland. Given that rewetting is likely to trigger conversion of land-use (for example to paludicultural use) and takes time and effort to prepare and implement, the suggestion is to include as part of the target-milestones a rather low percentage of rewetting by 2030 (7,5%) which would still mean substantial areas to be rewetted for Germany and Poland followed by Netherlands, Ireland and Finland.

The percentages of the target are inspired by two publications from Germany and Netherlands scientific bodies that are both proposing targets on the matter:

1. *"Towards net zero CO_2 in 2050: An emission reduction pathway for organic soils in Germany"*[53] is a scientific study from 2021 setting out two pathways to carbon neutrality in Germany. The first pathway is slower and goes from dry to moist and then to wet conditions over time, while the second targets directly at wet conditions. The more gradual pathway requires the following interim (2030, 2040) and ultimate (2050) milestones:
   - Cropland use stopped and all Cropland converted to Grassland by 2030;
   - Water tables raised to the soil surface on 15% /60%/ 100% of all Grassland;

   The end-result in 2050 is the same for both pathways, namely a near to 100% rewetting of organic soils, whereby the study considers that most of this area would be used for paludiculture (including grazing). The percentages proposed now for the EU target are somewhat lower than the ones suggested in the study, setting a target for both grassland and cropland together, leaving it to Member States how to approach the target and divide

[53] http://www.mires-and-peat.net/pages/volumes/map27/map2705.php : Towards net zero CO2 in 2050: An emission reduction pathway for organic soils in Germany by Franziska Tanneberger et al,

it between grassland and cropland. We argue this by the focus of the restoration law on the win-win approach with biodiversity gains, where not only the sheer surface under restoration measures and rewetted but also the location of the rewetted areas and the quality of the restoration measures play an important role.

2. *"Stop Land Subsidence in peat meadow areas"*[54] is a publication of the Dutch Advisory Council on Environment and Infrastructure of September 2020 and recommends targets capable of stopping land subsidence in the 'Green Heart' of NL: It suggests an indicative target to achieve 70% less land subsidence in rural peatlands by 2050 with an interim target of 50% by 2030. To counter land subsidence in peat meadow areas, the groundwater level needs to rise. While the target is not area-based, it is recommended to take an area based approach with zoning whereby some exceptions should be possible where the target cannot be reached (e.g. for areas with thin peat layer and little subsidence the target would be disproportional).

   The Council argues that continuing to increase drainage of peat-meadows is no longer acceptable, because:

   - drainage leads to reduced water quality, a deterioration in the quality of the natural environment and greater safety risks.
   - drained peat produces high CO_2 emissions, while the Dutch CO_2 emissions must be drastically reduced over the next 30 years (for the Netherlands by 95% compared with 1990 levels)
   - if policy remains unchanged, the costs of water management in peat meadow areas will continue to rise.

Table IX-1 MS where drained peatlands (organic soils) under agricultural use constitute more than 1% of their agricultural land (sources: national UNFCCC reporting, and Martin and Couwenberg 2021)

MS		Grassland on organic soil (in km²)	Cropland on organic soil (in km²)	Total agricultural area (in km²)	Total organic soil (in km²)	% of agricultural land on organic soil	Rewetting target options in km²				
							7,5%	**25%**	**35%**	**50%**	**70%**
1.	**NL**	2774,0	608,0	22916,5	3382	14,8	254	845	1184	1691	2366
2.	**FI**	669,1	2625,2	27333,1	3294	12,1	247	824	1153	1648	2310
3.	**DE**	9704,8	3421,4	194287,1	13126	6,8	984	3281	4594	6563	9184
4.	**IE**	3329,3	0	49361,9	3329	6,7	250	832	1165	1664	2324
5.	**LV**	796,9	786,3	24993,4	1583	6,3	119	396	554	791	1106
6.	**EE**	480,3	283,9	12786,8	764	6,0	57	191	268	382	532
7.	**DK**	516,2	1274,3	32339,6	1791	5,5	134	448	627	896	1246
8.	**PL**	7616,9	1601,0	180942,8	9218	5,1	691	2304	3226	4608	6454
9.	**SE**	277,2	1370,1	33071,7	1647	5,0	123	412	576	824	1148

[54] https://www.rli.nl/sites/default/files/advisery_report_stop_land_subsidence_in_peat_meadow_areas.pdf: Stop Land Subsidence in peat meadow areas – The Green Heart Area as an example" Council for the Environment and Infrastructure, September 2020

10. LT	686,0	640,0	35640,2	1326	3,7	99	331	464	662	924

Depending on socioeconomic and ecological context, fully rewetted organic soils can either be[55]:

- Taken out of productive use (e.g. through land purchase/acquisition or compensation) and reverted to fallow land or restored to near-natural status and placed under conservation.
- Converted to alternative sustainable land uses such as
  - Agricultural production of biomass crops using paludiculture on arable land with high water table,
  - Extensive grazing on grassland established on organic soil with water table raised to soil level or above during winter and lowered to up to 30 cm below during spring or summer grazing (provided capillary action within soil maintains soil saturation).

Unlike increases in carbon stocks which can take years to happen following management changes, avoided losses from rewetting result in immediate improvements. Therefore, the option aiming to rewet drained organic soils, and thus avoid their current emissions, can and must be pursued urgently.

Option 2: ***Focus on conserving and increasing SOC in mineral soil under arable land and permanent cropland and avoid the conversion of grassland to arable land to reverse current losses with an annual growth rate of 0.4%.***

Carbon stocks in EU-27 agricultural soils are estimated to be around 13,350 Mt C (or 48,950 Mt CO_2eq) in the top 0-30 cm. An estimated annual carbon input increase of around 0.66 ± 0.23 MgC[56][57] would be needed to achieve a growth rate of 0.4%. A review of European studies assessing the feasibility of increasing carbon stocks in agricultural SOC stocks revealed that achieving the overarching target of 0.4% target across the EU is currently very difficult to reach in technical and economic terms. Despite this, there is a clear scope and even clearer need to reduce and reverse SOC losses on agricultural land. Therefore, while the 0.4% target is a good aspirational target which will be supported by the EU's participation in the 4per1000 initiative, in the context of a legally binding instrument for restoration we suggest a more realistic target which aims to maintain and increase SOC in mineral soil under agricultural land to achieve an increase of 404 MtCO_2eq in EU stocks by 2030 (up to 30cm) against the BAU baseline.

A cumulative increase of 404 MtCO_2eq by 2030 in EU SOC stocks in mineral top soils (up to 30cm) corresponds to an annual growth rate of 0.09 % in the soil carbon stocks in mineral top soil, starting from 2024. This target could technically be achieved with the application of best management practices, excluding the conversion to grassland, on all EU arable land. Here, it is extended to all agricultural land, including permanent grassland and permanent cropland, giving

[55] Buschmann, C., Röder, N., Berglund, K., Berglund, Ö., Lærke, P., Maddison, M., Mander, Ü., Myllys, M., Osterburg, B. and van den Akker, J., 2020. Perspectives on agriculturally used drained peat soils: Comparison of the socioeconomic and ecological business environments of six European regions. Land Use Policy, 90, p.104181.
[56] Bruni, E., Guenet, B., Huang, Y., Clivot, H., Virto, I., Farina, R., Kätterer, T., Ciais, P., Martin, M., and Chenu, C.: Additional carbon inputs to reach a 4 per 1000 objective in Europe: feasibility and projected impacts of climate change based on Century simulations of long-term arable experiments, Biogeosciences Discuss. [preprint], https://doi.org/10.5194/bg-2020-489, in review, 2021.
[57] NB The Bruni et al 2021 study highlights that the SOC CENTURY model used might overestimate the effects of additional inputs on SOC stocks.

more flexibility on how it can be achieved. On permanent grassland, there is less scope to enhance stocks and the main goal is to maintain current ones, particularly by avoiding their conversion to arable land. However, in some cases, they could contribute to the target as changes in grassland management can increase stocks. Permanent cropland represents a small fraction (3%) of EU agricultural land. However, changes in their management could contribute to increasing SOC stocks particularly in regions with a higher share of permanent crops.

Local carbon sequestration potentials will vary across the EU as they depend on soil and climate variables. This target is set at the EU level allowing for variation in MS contributions. Practices which increase SOC stocks should be implemented following regional guidance adapted to local contexts. The permanent conversion of arable land to grassland is particularly relevant as well as the maintenance of grassland and banning of ploughing on permanent grassland. Measures on arable land include improved crop rotations, residue management, cover cropping, agroforestry, and organic farming.

This proposed target is deemed technically realistic and likely implementable for agricultural soils. Its implementation may require substantially changed policy and economic environment for farmers and would have significant societal benefits. The feasibility of the target should be further assessed to determine what changes in management are needed and where to achieve it using more regionalized alternative management scenarios and whether the subsequent stock changes are measurable by 2030. SOC stock changes can take several years after restoration has started, and it takes at least 5 (up to 20) years for SOC to stabilize. The proposed SOC enhancement target is based on modelling which showed the annual stock growth rate that would be achievable to 2050 by applying SOC management practices on all arable land in 2014. Since stock growth rates will decrease over time as a new equilibrium is reached, this growth rate is deemed realistic up to 2030. Another option to consider is to implement action-based targets based on the measures expected to deliver the necessary SOC improvement by 2030 so that progress can be measured before stock changes respond to management change. In addition, soil carbon sequestration potentials should be assessed beyond 2030 to determine a realistic target towards 2050.

The feasibility of setting a similar target on other managed soils (particularly for forest soils) should also be evaluated.

Option 3: Decrease soil erosion by water on soils under agricultural use and decreasing the area of agricultural soils with severe erosion levels (over 10 t/ha/year)

Stopping unsustainable soil erosion could be a useful indicator of progress towards SOC improvement, with focus on erosion by water as the pressure with the largest magnitude, spatial extent, and measurability. Most practices that enhance SOC content also reduce soil erosion such as cover crops, buffer strip and grassland conversion. Other measures also have clear benefits for erosion reduction include contour cropping and ploughing, terracing, reduced and zero tillage, measures to reduce soil compaction and other water management practices such as earth banks, lined water banks and water retention areas. However, there is limited evidence for measurable increases in SOC for these. Following the same reasoning as under Option 2, the focus is on decreasing erosion in soils under agricultural use.

This target should be further evaluated to determine measurable milestones to be reached by 2030, 2040 and 2050.

Option 4: Focus on improving SOC in mineral soils under forestry and rewetting drained organic soils under forestry (73 000 km²).

Sampling and data for forests SOC is currently insufficient to propose a target to reduce SOC losses from managed forest land. However, a coherent EU level monitoring framework and methodology for measuring SOC content and stock is being developed and there are ongoing discussions to support Member States by improved sampling. The feasibility of proposing a legally binding target for mineral soils under forestry should be re-evaluated once these systems are in place. This is particularly urgent as increased moves towards a bio-economy might increase pressures on forests by increasing harvesting rates and thus possibly increasing loss from managed forest soils. The feasibility of a target for rewetting organic soils under forestry could not be evaluated. The carbon gains from rewetting forest soils are uncertain as many of the soils are only partly drained and thus losing carbon at a lower rate compared to agricultural soils. Nevertheless, organic soils drained for forestry are an important source of carbon emissions.

Table IX-2 Summary table screened target options

Target option	Screened in/out for assessment	Key reason(s) for screening in/out
Restoring and rewetting organic soils under agricultural use	Screened in	Feasible conversion measures demonstrated in pilot projects. High biodiversity benefit and at the same time most important measure for overall carbon benefit.
Conserve and increase SOC in cropland and avoid the conversion of grassland to arable land to reverse current losses with an annual growth rate of 0.4%	Screened in but modified to: Achieve a cumulative increase of 404 MtCO2eq by 2030 in EU SOC stocks in mineral topsoils (up to 30cm) under agricultural land.	Feasible and currently economic measures available on cropland and grassland. Annual growth rate of 0.4% not considered feasible in many regions.
Decrease soil erosion (and stop unsustainable soil erosion)	Screened in	Feasible and effective measures available. Measurable.
Improve SOC in mineral soils under forestry and rewet drained organic soils under forestry	Screened out	Not currently sufficient data to assess feasibility and effectiveness.

6.4 Impacts of assessed target options – qualitative overview

A full quantitative assessment of the impacts of meeting restoration targets for soils is not possible at this stage, because insufficient data are available to quantify the extent of measures required and hence their benefits and costs. To carry out a full quantitative impact assessment of achieving SOC targets in relation to the expected baseline to 2030, more detailed work is needed to (1) further develop specific targets, (2) determine what measures are needed where to estimate the applicable area for the different soil management measures proposed based on overall degradation extent, and (3) collect and synthesize data on the costs and benefits of SOC restoration measures across

European regions. Here, the likely costs and benefits of each option are qualitatively assessed and, where possible, illustrative per hectare values are presented based on existing studies[58].

Option 1: ***Focus on rewetting drained organic soils (drained peatlands) under agricultural use (both grassland and cropland) and losing carbon (52,000 km²).***

Stakeholders affected: While society benefits from organic soil restoring and rewetting trough a wide range of environmental benefits (emission reduction, less flooding risk, cleaner water, etc.), the costs are directly borne by land managers. Similarly, land managers obtain profits from drained peatlands, while there are externalized costs for society. Individual land managers will most likely have to adapt and change agricultural practice after rewetting and might suffer losses to different extents from rewetting and compensation schemes should be considered.

Agricultural use after full rewetting: Paludiculture ('palus' – latin for 'swamp') allows the productive use of rewetted peatland in ways that preserve the peat body, thereby stops subsidence and minimises emissions.

In contrast to drainage-based agriculture, paludiculture cultivates crops that are adapted to high water levels, such as reed, cattail, black alder and peat mosses. The aboveground biomass is harvested and the belowground biomass can form new peat. It can have a higher value both financially and ecologically. Using a variety of established techniques, the products of paludiculture can be processed to use as insulation and construction materials, growing media and bio-refinery products as well as for livestock fodder and for fuel. Innovative products, including, cosmetics, medicinal and food products, are under development.

Large-scale implementation of paludiculture, however, requires agricultural policies to set explicit incentives that ensure that it becomes advantageous for landowners to rewet drained agricultural peatlands and subsequently to maintain them as wetlands. To stop carbon emissions it is essential that the ground water levels in rewetted peatlands are much more close to the ground surface for most of the year (target level: +20 to -20 cm). Also grazing with traditional commercial cattle breeds is becoming increasingly difficult under these circumstances because of the detrimental trampling effects that destroy the peat layer and bring oxygen in the soil.

Paludiculture implies a transition to new agricultural practices and the use of new adapted machinery, which can be enabled and promoted through agro-environmental schemes.

Costs: include upfront investments to implement restoration measures, maintenance costs, and transaction costs. Available data on upfront and maintenance rewetting costs is currently anecdotal. Indicative ranges for upfront costs of €235-11,750/ha restored (with average costs from €955/ha - 4,735 €/ha) for one-off costs and €29-470/ha/year for maintenance costs. These large ranges reflect cost variation due to differences in ongoing management, degree of degradation, peatland type, and other ecological and socio-economic variables. Rewetting soil which is currently under productive land uses can come at a considerable opportunity cost. On average in Europe, they are estimated to be around €525/ha/year. This is an illustrative value as costs are

[58] Buschmann, C., Röder, N., Berglund, K., Berglund, Ö., Lærke, P., Maddison, M., Mander, Ü., Myllys, M., Osterburg, B. and van den Akker, J., 2020. Perspectives on agriculturally used drained peat soils: Comparison of the socioeconomic and ecological business environments of six European regions. Land Use Policy, 90, p.104181.

context dependent with higher costs associated with organic arable soils under highly productive use, and lower costs with soils which support low level grazing. Organic soils represent a high proportion of arable land in some countries (e.g. Netherlands, Finland and Germany) where rewetting will consequently have a larger socio-economic impact. At the EU level however, agriculture on organic soil represents only around 1% of cropland and 4% of grassland (EU-15) meaning overall costs from lost productivity on these soils will be small relative to their climate and biodiversity benefits. Depending on the socioeconomic and ecological context of a given site, losses can be compensated through land purchase/acquisition and acquisition or by incentivising the establishment of alternative land uses such as paludiculture or extensive grazing.

Benefits: High climate change mitigation and adaptation benefits are expected from rewetting. Rewetting drained agricultural soils can lead to decreases in emissions of around 20 tCO_2eq/ha/year which if applied to the 52000 km² estimated, would lead to 104 Mt of avoided CO_2 emissions per year. Using an estimated social cost of carbon of €100/tCO_2eq, this would result in potential benefits of up to €2000/ha/year. Other studies looking at the GHG mitigation and carbon stocking potential of rewetting agricultural organic soils range from 3.4 – 22.8 t CO_2eq/ha/year, equivalent to €340-€2724/ha/year. Besides these climate benefits rewetting will bring significant biodiversity benefits as well. The re-establishment of wetlands, also if cultivated via paludiculture can be beneficial to the occurrence of a wide range of wetland habitat types and to many bird species including herons, storks, swans, geese, ducks, harriers, crakes and rails, cranes, waders, meadow birds, snipes, warblers of which many are endangered in the EU. In addition, aquatic and semi-aquatic mammals, amphibians, reptiles invertebrates and particular fish species (including many species protected under the Habitats Directive) can benefit. Wetland-restoration and paludiculture can also facilitate the connectivity of wetland areas and their species populations in the EU. Moreover, rewetting creates benefits for water quality, flood risk mitigation, drought risk mitigation and socio-economic benefits from paludiculture and tourism.. Moreover, rewetting ensures the long-term sustainability of production on organic soil (e.g. via paludiculture and extensive grazing) as it avoids subsidence and the eventual complete degradation of soil. Quantifying these benefits is challenging but they are considerable. Studies estimating the value of multiple ecosystem services benefits after rewetting estimated median value of €1045 per hectare per year (from €164-€4895).

Cost-benefit assessment: Rewetting organic soils is a cost-effective measure to reduce greenhouse gas emissions, more so than increasing SOC on mineral soils. Climate benefits are the most straightforward to quantitatively estimate. Taking the illustrative per hectare cost and benefit estimates outlined above, we calculate it would take around 6 years for the carbon benefits of restoration to outweigh costs. Another approach is to use estimates of costs per avoided tonne of CO_2 which range from €7-85 and €27-105 when considering opportunity cost. Considering the social cost of carbon is estimated at around €100 per tonne and solely considering climate change mitigation, the benefits of implementing this option outweigh costs. The ratio between benefits, including biodiversity benefits and costs is expected to be considerably larger when also considering other ecosystem service, including tourism and socio-economic benefits which are challenging to quantify.

Option 2: ***Achieve a cumulative increase of 404 $MtCO_2eq$ by 2030 in EU SOC stocks in mineral topsoils (up to 30cm) under agricultural land.***

Stakeholders affected: The measures considered under this option mainly target cropland. Stakeholders affected are primarily land managers responsible for implementing the measures which include arable farmers, but also most livestock farmers through measures for fodder crops, temporary and permanent grassland that is regularly refreshed.

Costs: Cost estimates from studies assessing the implementation of SOC conservation measures vary widely as studies follow different methodologies, include different soil management measures, and are based on regions with different pedo-climatic and socioeconomic contexts. Typically, values range from €100 to 1000 /ha/year with an average of around €280/ha/year.

Benefits: Inaction on SOC decline costs the EU €3.4-5.6 billion every year[59]. Addressing SOC decline can avoid these large costs while delivering a range of additional on-site and off-site benefits. This target will deliver climate change mitigation benefits through increasing carbon sequestration in EU-27 agricultural land by 404 $MtCO_2eq$ by 2030 (equivalent to 0.31 tCO_2eq/ha/year). Applying a carbon value of €100 per tCO_2 equivalent, this would result in an economic benefit of around €40.4 billion from 2022-2030 and €31/ha/year. For specific measures, carbon stock increases range from 730 and 630 kgC/ha/year in the case of converting arable to grassland and implementing agroforestry practices respectively, to more modest increases between 15 and 30 kgC/ha/year in the case of grazing management, planting hedges, straw incorporation, and applying exogenous organic materials (EOMs).

Other key benefits include biodiversity benefits by enhancing above and below ground habitat health, and increased crop yields, reduced erosion and increased water retention leading to increased resilience of agricultural production, natural hazard risk mitigation and food security. In addition, improved soil health that can benefit plant health and thus improve resilience towards droughts and increasing pests. These all lead to considerable climate adaptation benefits which may even outweigh the mitigation benefits of enhanced SOC[60, 61]. In addition, measures can also reduce costs to farmers as they reduce input costs by, for example, reducing pesticide and fertilizer use.

There is a very high variation in estimated monetary benefits from SOC enhancement. A recent meta-review found soil protection measures deliver benefits ranging from €0 to €3440/ha/yr (average €93/ha/yr)[62]. Another study found overall on-site benefits from SOC conservation and enhancement on agroecosystems have been estimated at €2.1bn/yr over 20 years in the EU-25.

Cost-benefit assessment: Currently available information is not sufficient to provide a reliable estimate of the cost benefit ratio of SOC management as there is a wide variation in cost and benefit estimates across regions and restoration methods. Studies comparing potential costs and benefits

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[59] European Commission (2006a) Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of Regions – Impact Assessment of the Thematic Strategy on Soil Protection. SEC(2006)620 (http://ec.europa.eu/environment/archives/soil/pdf/SEC_2006_620.pdf)

[60] Powlson, D. S., A. P. Whitmore, K. W. T. Goulding (2011) Soil carbon sequestration to mitigate climate change: A critical re-examination to identify the true and the false. European Journal of Soil Science, vol. 62, no. 1, pp. 42–55.

[61] Amundson, R. and Biardeau, L. (2018) Opinion: Soil carbon sequestration is an elusive climate mitigation tool. Proceedings of the National Academy of Sciences of the United States of America, vol. 115, no. 46, pp. 11652–11656.

[62] Tepes, A, Galarraga, I, Markandya, A and Sánchez, M J S (2021) Costs and benefits of soil protection and sustainable land management practices in selected European countries: Towards multidisciplinary insights. Science of the Total Environment No 756, 143925.

from key SOC enhancing measures reveal no generalisations can be made across regions and practices yet, in many cases, benefits outweigh costs, especially for low-cost measures such as including legumes in rotations. Some measures can result in a net cost to farmers which, with the right incentives, can be minimised. These costs will likely mostly happen over the first couple of years, and, with time, benefits might outweigh costs. Measures to improve SOC are crucial to maintaining productive capacity and are therefore vital for agricultural resilience and sustainability in the long-term.

There is a wide variation in estimates of the costs and benefits of SOC restoration due to heterogeneity between sites in pedo-climatic, management and socio-economic variables. Since extrapolating per hectare values across regions will not yield accurate cost estimates, this assessment did not attempt to calculate the cost-effectiveness of the option at the EU level. Similarly, more information is needed on what measure is needed where. Further assessments should address these gaps.

Option 3: ***Focus on decreasing soil erosion*****.**

Stakeholders affected: As in option 3, measures are primarily on cropland and therefore affect arable farmers.

Costs: The measures evaluated under this option include those with evidence for decreased soil erosion but not SOC enhancement. Water management options such as buffer strips are typically low-cost. Contour ploughing and water management is considered cost-effective but not applicable to many areas while the cost-effectiveness of reduced or zero- tillage practices is highly context dependent.

Benefits: In addition to likely enhancing SOC, reducing soil erosion will generally improve soil health and structure and contribute to maintaining soil fertility and crop yields, decreasing water runoff leading to higher water quality and decreasing flood risk and off-site effects and costs of soil erosion. The evaluation in support of the EU soil thematic strategy calculated overall yearly on-site benefits of around €500 million from soil erosion control.

Cost-benefit assessment: Measures to decrease soil erosion in farmlands can be cost-effective but, in some cases, they can result in an initial net cost to farmer due to short-term loss of income from reduced maximum yield potential on the field per year. However, these costs might be outweighed by benefits in the mid-term (3 – 4 years) such as increased drought resilience.

For all options, additional costs can be expected from planning, enforcement, administration, advice and training, research, communications, and monitoring. Most of these costs are likely to be small compared to the costs from soil protection, restoration, and management measures. Monitoring might involve considerable costs as current systems have to be scaled up and some methods such as in-field SOC monitoring can be time and resource intensive. These impacts will mostly affect national and regional authorities, relevant environmental organisations as well as land managers involved in monitoring.

Quantified estimates of soil protection costs and benefits at the EU level are currently limited by a lack of data, uncertainties in extrapolation of values across regions, heterogeneity of approaches and methodological and conceptual difficulties in calculating the monetary value of benefits from ecosystem services. Very few studies assess individual SOC conservation measures separately.

Table IX-3: Summary of the expected types of costs of achieving restoration targets for soils and, where available, estimates of the range of the cost per hectare restored.

Option	Types of costs involved	Main costs	Potential magnitude range (EUR/ha)
Option 1: Rewetting organic soils	Upfront investments to implement restoration measures	Materials for drainage closure and other restoration works. Transport of materials, especially where helicopters are required. Installation of water-control structures and impermeable bunds. Salaries and equipment of contractors	Variable (€955/ha - 4,735 €/ha)
	Maintenance costs	Management to maintain water table level.	Variable (€29-470/ha /year)
	Administrative and transaction costs	Costs of administering programmes and schemes e.g. agri-environmental schemes	Low
	Opportunity costs	Opportunity costs of changing agricultural practice and production, compensation for the reduction or removal of land from productive agricultural use. Land acquisition of rewetted land taken out of productive use can be taken as proxies of these costs.	Potentially high for individual farmers but low for the EU as a whole considering the low proportion of EU agriculture on organic soils
Option 2: Agricultural soils	Upfront investments and maintenance costs related to restoration measures	Highest costs associated with conversion of arable to grassland and the implementation of new farming systems such as agroforestry. Some measures result in maintenance costs e.g. EOM or cover crops.	Variable (€100-1 000 /ha/year)
	Administrative and transaction costs	Costs of administering programmes and schemes e.g. eco-schemes	Low
	Opportunity costs	Crop rotation changes might sometimes decrease productivity. Increase in grassland can reduce productive land and related income. Payments to farmers needed to compensate these.	Low- medium
Option 3: Soil erosion	Upfront investments and maintenance costs	Semi-permanent and permanent structures require the largest investments (e.g. from £32/ha for buffer strips to £670/ha for shelterbelts). For measures only relevant to erosion, terracing is the most expensive. Costs will vary geographically with areas with highest erosion requiring higher investment.	Variable (€34-1 000 /ha/year)
	Maintenance costs	High for terracing	Variable (€0-227 /ha/year)

Table IX-4: Summary of qualitative benefits from Soil Ecosystem Restoration. Insufficient information to estimate accurate monetary benefits at this stage.

Option	Types of benefits involved	Main benefits	Potential magnitude)
Option 1: Rewetting organic soils	Climate change mitigation	Rewetting peatland soils in grassland and arable systems nearly completely avoids an average of 7.5 t SOC /ha/yr.	Very high (around €2000/ha/year based on price of €100/tCO_2eq or €340-€2724/ha/ year based on literature)
	Biodiversity	Restored wetlands will result in significant biodiversity benefits given that wetlands are the ecosystem that has lost	High to very high

		enormous surfaces in the past decades in the EU and is in urgent need for restoration.	
	Other ecosystem services	Flood risk mitigation and water quality control	High in flood prone areas
	Socio-economic	Benefits from sustainable uses of rewetted land - paludiculture, wet grassland grazed by water buffalo	Low/ moderate
Option 2: Agricultural soils	Climate change mitigation	Increased SOC increases carbon storage in soils. High benefits from conversion of cropland to other land uses and for agroforestry.	€31/ha/year
	Biodiversity	Increased soil quality leading to enhancement of soil processes needed to sustain above and below ground biodiversity. Improved habitat stability and resilience.	Unknown
	Other ecosystem services	Increased water quality and quantity management, Flood risk mitigation, Erosion control, Potential cultural services including recreation and tourism and preservation of archaeological sites (uncertain)	High High High Low/ unknown In total: € 0-3440 /ha/yr (average €93 /ha/yr)
	Socio-economic	Increased crop yields and productivity and potential direct payments from carbon farming schemes to farmers.	Potentially high
Option 3: Soil erosion	Climate change mitigation	Contribute to reduced losses in SOC.	Medium
	Biodiversity	Increased soil quality will benefit below and above ground biodiversity	Unknown
	Other ecosystem services	Increased soil fertility, reduced flood risk, increased water retention and quality	High
	Socio-economic	Increased crop yields and productivity	Potentially high

Source: see soil impact assessment fiche for references and evidence used

6.5 Synthesis

Overall, there are strong arguments for soil restoration targets addressing the protection of SOC stocks in organic soils and their maintenance and enhancement on mineral soils under agricultural usage and soils threatened by water erosion. Even though ecosystem accounting is currently not sufficiently developed to fully quantify costs and benefits across the EU, the proposed targets are expected to deliver large benefits for climate action, biodiversity and other associated ecosystem services. Overall, there is a strong socioeconomic argument for implementing soil restoration targets due to the high value of their co-benefits, win-wins with biodiversity gains and avoided costs. A global assessment on land degradation neutrality found that, across biomes, the benefits of restoration are up to 10 times higher than the costs. For Europe specifically, benefits of action against land degradation were found to outweigh costs by a factor of 6 in Western Europe and a factor of 6.5 in Eastern Europe over a 30-year horizon. However, further assessment is needed to determine EU wide targets that can be met in an economically attractive way.

Restoring and fully rewetting organic soils is the target option developed the most as it delivers besides high climate benefits the strongest biodiversity gains and is particularly urgent. Also some of the countries most affected like the Netherlands and Germany have already (or are in the stage of developing) ambitious rewetting programmes, projects and targets. Studies and pilot projects in arable regions demonstrate their feasibility and cost-effectiveness.

Enhancing and maintaining EU SOC stocks in mineral soils under agricultural use by 404 $MtCO_2eq$ by 2030 also has clear benefits for climate mitigation and adaptation as well as food security and ecosystem health. Reducing unsustainable soil erosion is expected to contribute to safeguarding soil carbon and restoring soil health and avoiding significant costs from natural hazards associated with climate change.

Action on organic soils would be required mainly from Member States in northern and western Europe (Netherlands, Germany, Poland, Finland, Ireland,…); action on soil erosion from MS with soil erosion hotspots (e.g. the Mediterranean region, Bavaria, Slovakia.). An overall target on SOC would require a package of actions primarily focused on arable land, most of which are well-established actions. Although feasibility, effectiveness, efficiency, and proportionality of specific measures is highly context specific and would have to be assessed at a regional level, reaching a SOC target at the EU level would achieve improvements in soil health which are indispensable for future sustainable land use and food production.

Monitoring and reporting systems are available and can be improved to work better for a quantified soil target. The LUCAS soil monitoring programme initiated in 2009 offers a harmonized, regular EU-wide approach to assess SOC and provides data for MS which do not have their own soil monitoring system. The LULUCF regulation provides annual reports about emissions from organic and mineral managed soils. Importantly, the feasibility and potential of restoration targets on forest soils should be re-evaluated in future considering ongoing work to improve monitoring and reporting framework for EU forest soils. The need for improved monitoring for SOC is further justified due to the relevance of SOC as an indicator for a variety of other EU and international policies.

Further work should focus on developing the proposed targets, determining what measures are needed where, assessing the feasibility of expanding its scope to including other ecosystems (particularly forests), and other dimensions of soil health. This would include projects, research and collaborations to improve understanding and assess the potential of setting targets for soil biodiversity, compaction, contamination (point source and diffuse), sealing and salinization.

Table IX-4: Overview table assessing options on EU impact assessment criteria

Criterion	Organic soils	SOC in agricultural soils	Soil erosion
Feasibility / effectiveness	High on feasibility and effectiveness. The particular strong win-win situation with climate & biodiversity is already triggering the relevant measures which will need upscaling Monitoring the increases of SOC on organic soils builds on MS's experiences for LULUCF reporting, and the discussions on the CAP reform. The diverse and numerous experiences with wetland restoration (e.g. LIFE) show the effectiveness of the approach.	High feasibility. Builds on various political and environmental objectives. Agricultural practices are sufficiently known to guide implementation. Carbon sequestration is currently mapped by all MS and can build on current national submissions for the LULUCF sector to the European inventory and LUCAS soil survey. To be effective, stock increases need to be preserved long-term.	Moderate feasibility. Funding for addressing erosion in UAA is already available within CAP. Need for region specific guidance on most appropriate measures. Hotspots should be identified and prioritised.
Efficiency	Considered to be one of the most cost-effective measures to reduce greenhouse-gas emissions and at the same time boost biodiversity, particularly	No generalisations can be made across regions and practices yet, in many cases, benefits outweigh costs, especially for low-cost measures such as	Measures to decrease soil erosion in farmlands can be cost-effective but, in some cases, they can result in net costs to

	if rewetting is done on a large scale.	including legumes in rotations. Some measures can result in a net cost to farmers which, with the right incentives, can be minimised.	farmers for which they should be compensated.
Coherence	High coherence with EU climate goals. Also, high coherence with biodiversity objectives as re-wetting can lead to restoration (and in some cases recreation) of habitats protected under Annex 1 of the EU Habitats Directive and will in nearly all cases benefit a range of declining species. Farm incomes might be affected depending on the national implementation of the rewetting target (i.e. via mandatory regulations or voluntary agri-environment measures) and depending on the national CAP measures & payments. In the long-term impacts on farm income would be positive due to greater sustainability of production.	High coherence with EU climate goals and ambitions for new soil strategy outlined under the EU biodiversity strategy for 2030. SOC is a proposed CAP impact indicator. Impacts on farm income are like those under option 1 with even higher long-term positive benefits due to increased yield from increased SOC and soil health.	High coherence with CAP objectives, farm to fork objectives and zero pollution action plan objectives. Coherence with climate adaptation goals as it increases disaster risk resilience to floods and landslides while improving food security. Impacts on farm income are like those under option 2 with possible short-term losses likely offset by long-term productivity gains from improved soil health.
Proportionality	This target is proportionate as in the EU agriculture on organic soil represents a small fraction of agricultural land (around 3%) meaning overall costs will be lower than their potentially huge climate and wider ecosystem benefits. Protecting organic soils supports and further stimulates efforts already established by many MS, through their national programming, funding and legislations in soil protection, sustainable land management, nature protection, and climate change.	The option is deemed proportionate as it will involve targeted regional measures to address gradually a significant problem which threatens the future sustainability of land use and food production. Costs and benefits mainly on arable land and highest in Mediterranean region	Overall, the target is deemed proportionate as it will target areas with greatest problems and will address a big problem in a proportionate way. Effort heavily skewed to Mediterranean countries
Conclusion	**Include as a target**	**Do not include now, consider further in a possible second stage (or possibly considered in the announced soil health legislation)**	**Consider further as a possible second stage target (will require further assessment) or possibly considered in the announced soil health legislation.**

10. Pollinators

10.1 Scope

Wild pollinators include all flower-visiting species that contribute to the transfer of pollen, excluding managed species such as the honeybee (*Apis mellifera*). In Europe, wild pollinators are principally insects, such as bees, hoverflies, butterflies, and moths. The EU has a high diversity of pollinator species - 2,000 species of bees, around 1000 species of hoverflies, almost 500 species of butterflies, and almost 1,000 species of hoverflies plus thousands of species of moths, flies, wasps, beetles and other insects which act as pollinators. [63]

Wild pollinator habitat is treated as all natural, semi-natural and artificial habitat that provides suitable food (flowers), shelter, nesting, and overwintering sites.

This species target fully complements the targets for agro-ecosystems, heath and scrub, forests, wetlands, and the urban green spaces. It relies on some of the assessment done under those ecosystems.

10.2 Problem, current trends and ecosystem-specific baseline

Pollinator populations

Wild pollinator communities are indicators of ecosystem health and react quickly to environmental change. Wild bees indicate small-scale habitat diversity as they interact with the landscape in a complex life cycle, within a radius of a few hundred metres. Butterflies react quickly to change, in response to micro-climate and other factors as well as vegetation. Moths and some butterfly species are indicators for structurally diverse forests (mosaics with diverse forest edges, open habitats, mature canopies of native tree species). Many hoverfly species are indicators of conservation management because their larvae are restricted to specialised niches, such as particular types of rotting wood or tree species on which they feed on aphids or other insects.

84 % of the crops grown in Europe benefit at least partly from animal pollination[64], including fruits, vegetables, nuts, oil crops, pulses and legumes, crops grown for fibre or fuel or for animal food. Over 78 % of wild plants in the EU rely on pollinating insects, [65] including many medicinal plants. Without pollinators, these plants would disappear resulting in the cascading loss of biodiversity and ecosystem services, such as biological pest control or decomposition provided by some hoverfly larvae[66].

While the full magnitude of the decline is still not fully understood, the existing data clearly points to an alarming loss of pollinators in the EU: the EU Red List of Bees[67] shows that one in three bee and butterfly species are declining, while one in ten are on the verge of extinction; the Grassland

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[63] Potts et al., (2020) Proposal for an EU Pollinator Monitoring Scheme.
[64] Williams, I.H. (1994) The dependence of crop production within the European Union on pollination by honeybees.
[65] Ollerton et al., (2011). How many flowering plants are pollinated by animals?
[66] Hatt et al., (2017) Pest regulation and support of natural enemies in agriculture: Experimental evidence of within field wildflower strips.
[67] Nieto et al., (2014) European Red List of Bees. Publication Office of the European Union, Luxembourg.

Butterfly Indicator shows a loss of 25 % of abundance in EU countries from 1990-2018[68]. Data at regional level shows decline of other pollinators within the general decline of insects, for example long-term monitoring in Germany shows significant declines in arthropods in grasslands and forests[69], and a 77 % decline in insect flying biomass in protected areas.[70]

The main pressures on pollinators are land-use change, intensive agricultural management and pesticide use, environmental pollution, invasive alien species, and climate change.[71]

The baseline assessment to 2030 suggests that the main pressures will continue, though impacts of pesticide use are expected to decline if objectives to reduce the risks and use of harmful pesticides and to increase the area under organic farming will be achieved. If the historical trend in the European grassland butterfly indicator continues, it would likely decline by 23% by 2030. It is not possible to extrapolate trends in other pollinators, but declines are expected to continue on agricultural land, particularly on high nature value farmland. Climate change combined with fragmentation limiting migratory routes will lead to extinctions in the southern and northern edges of ranges and in alpine species, whilst driving the expansion of some species to colonise new areas.

Crop pollination: There is evidence of current pollination deficits in crops associated with low abundance of pollinators; JRC estimated 50% of crop demanding crops in the EU are in pollinator deficient areas [72].

The INCA project developed a set of ecosystem accounts including crop pollination. Vallecillo et al, [73] estimated that in 2012 pollination contributed EUR 4.517 billion (estimated value in 1019: EUR 4.977 billion) in to the value of agricultural production in the EU, corresponding to 2 810 EUR per km^2. An estimated 51% of the area with pollinator dependent crops had a low pollination potential. The pollination gap of 51% is projected to widen since pollination potential slightly erodes (-1% per 10 years) whereas demand for pollination is increasing with 5% per 10 years. In the absence of restoration, the pollination gap is therefore expected to increase, assuming the demand from pollination dependent crops remains the same for the next decade (NB demand will probably increase as the area of pollination dependent crops increases with increasing use of legumes, changing demand, and changing opportunities due to climate change). The study therefore suggests that restoration of pollinator habitats has the potential to double the benefits from pollination.

Major knowledge gaps on pollinators still exist across taxa and geographical regions in Europe as noted by Potts et al [74], which pose barriers to the development and implementation of effective

[68] In the EU27, 5 of the 17 species in the indicator show a moderate decline, 6 are stable, and one species shows a moderate increase (*Anthocharis cardamines*). The trends for the remaining species are uncertain. Ref: (Van Swaay et al, 2020).

[69] Seibold et al., (2019) Arthropod decline in grasslands and forests is associated with landscape-level drivers.

[70] Hallmann et al., (2017) More than 75 percent decline over 27 years in total flying insect biomass in protected areas.

[71] IPBES (2016) The assessment report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services on pollinators, pollination and food production.

[72] Vallecillo et al., (2018) Ecosystem services accounting Part I Outdoor recreation and crop pollination. JRC Technical Reports.

[73] Vallecillo et al., (2018) Ecosystem services accounting Part I Outdoor recreation and crop pollination. JRC Technical Reports.

[74] Potts et al., (2020) Proposal for an EU Pollinator Monitoring Scheme.

management and policy responses to conserve the EU's pollinators and secure sustainable and resilient pollination services.

10.3 Target options screened in/out

Options for targets are:

1) **To achieve good condition[75] of pollinator species protected by the EU Habitats Directive**
The EU Habitats Directive lists 52 pollinator species in the annexes. These species are all Lepidoptera (butterflies and moths). The directive does not protect any Hymenoptera or Diptera, the most prominent pollinator groups including the most important pollinators of crops. This target would therefore only address a very small component of the pollinator community consisted of thousands of species, and only species that are relatively rare or restricted in occurrence. It therefore has low relevance to the overall aim of restoring pollinators and will not deliver the benefits that come from healthy pollinator populations.

2) **To achieve good condition of pollinator habitats protected by the EU Habitats Directive**
The EU Habitats Directive Annex I habitat types significant for wild pollinators include the semi-natural grasslands (particularly calcareous and hay meadows), most heaths (notably dry heaths) and scrub, many coastal grasslands and scrub, most wetlands and screes, and forest habitats with a high proportion of open and/or moderately disturbed habitat.[76] These habitats are associated with high species richness of pollinators, and their restoration is likely to increase pollinator species diversity and abundance. [77] However, these habitats are largely absent in more intensively managed landscapes (farmland and forest) and in urban areas. The target would therefore not cover actions addressing pollinator decline in the wider landscape[78].

3) **To reverse decline in pollinator populations.**
This target requires sufficient increases in pollinator-friendly habitat in all landscapes, and particularly Annex I grasslands, heaths and wetlands, and agro-ecosystems. It also requires actions to reduce pressures, notably to reduce pesticide use and nitrogen inputs (reduce fertilizer and decrease deposition). Achieving this restoration would ensure the restoration of the critical structural and functional role that pollinators play

[75] Good condition refers to species population, habitat, and range. This is a component of favourable conservation status (as defined in the EU Habitats Directive), which also includes the future prospects of the species (estimates of future threats, long-term viability of habitat, etc).
[76] Kudrnovsky et al., (2020) Report for a list of Annex I habitat types important for Pollinators. ETC/BD Technical paper 1/2020, Report to the EEA.
[77] Olmeda et al., (eds) (2019) EU Habitat Action Plan to maintain and restore to favourable conservation status the habitat type 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (FestucoBrometalia) (*important orchid sites) ; Olmeda et al., (eds) (2020) EU Habitat Action Plan to Maintain and Restore to Favourable Conservation Status the Habitat Type 4030 European Dry Heaths.
[78] Although the Habitats Directive requires periodic surveying and reporting on the condition of the habitats, no EU Member State currently surveys pollinators as an indicator of condition and there are no systematic surveys of pollinator species in these habitats. Thus, it is not currently possible to verify that the pollinator decline is reversed. The EU pollinator monitoring scheme aims to have systematic surveying in place by 2024.

across different terrestrial ecosystems, and especially in agroecosystems. Expert estimates indicate that restoration of pollinator habitat on at least 10% of farmland will be the minimum needed to maintain the most common wild pollinator species. [79]

Actions for pollinators on intensively managed farmland include[80]:

- Maintenance / creation of boundary features (e.g. ditches, banks, hedges and trees) with flowering shrubs & vegetation & nesting/breeding/shelter/hibernation niches;
- Creation of buffer strips / margins (e.g. along watercourses, by hedges, field corners) without pesticide & fertilizer drift;
- Planted strips for pollinators (flowering seed mixes), fallow (whole field / zones);
- Reduced pesticide use (including insecticides, herbicides, and fungicides), & adoption of IPM, reduced fertilizer use, organic management, tolerance of weeds;
- Late and/or lenient and/or delayed cutting and grazing of grassland, reduction in livestock densities, staggered cutting, extensification;
- Recreation of grassland from arable land, reseeding of impoverished grassland, halting reseeding of permanent grassland;
- Agro-forestry, planting flowering trees/shrubs on grassland, in hedges & field edges
- Diversification of crops (in space – diversity of crops in fields - and in time – crop rotations).

Current knowledge gaps can only be addressed through a large-scale standardized monitoring scheme. [81] It will therefore be necessary to establish and maintain monitoring and reporting of pollinator populations across the EU. Systematic pollinator monitoring will enable setting of a baseline and building of policy indicators of biodiversity at national and EU level, thereby helping improve the effectiveness of EU policies supporting land management and restoration, notably the CAP, regional funding, and protected area management. The Commission and Member States have already started working on a technical proposal for the EU pollinator monitoring scheme[82].

[79] Dicks et al., (2015) How much flower-rich habitat is enough for wild pollinators? Answering a key policy question with incomplete knowledge; Martin et al., (2019) The interplay of landscape composition and configuration: new pathways to manage functional biodiversity and agroecosystem services across Europe.
[80] Based on IPBES 2016 Table SPM1. Includes actions of England rural development programme farm wildlife package (pollinator subpackage).
[81] Harvey et al., (2020) International scientists formulate a roadmap for insect conservation and recovery.
[82] Potts, S G, Dauber, J, Hochkirch, A, Oteman, B, Roy, D, Ahnre, K, Biesmeijer, K, Breeze, T, Carvell, C, Ferreira, C, Fitzpatrick, Ú, Isaac, N, Kuussaari, M, Ljubomirov, T, Maes, J, Ngo, H, Pardo, A, Polce, C, Quaranta, M, Settele, J, Sorg, M, Stefanescu, C and Vujic, A (2020) Proposal for an EU Pollinator Monitoring Scheme. EUR 30416 EN, Publications Office of the European Union, Luxembourg. ISBN 978-92-76-23859-1, doi:10.2760/881843, JRC122225.

https://ec.europa.eu/jrc/en/publication/proposal-eu-pollinator-monitoring-scheme

https://publications.jrc.ec.europa.eu/repository/handle/JRC122225

Table X-1 Summary table screened target options

Target option	Screened in/out for assessment	Key reason(s) for screening in/out
To achieve good condition of pollinator species protected by the EU Habitats Directive	Screened out because of limited relevance and limited benefits compared to the other options	Insufficient scope to lead to recovery of pollinator populations
To achieve good condition of pollinator habitats protected by the EU Habitats Directive	Screened out because out because its scope does not cover intensively managed landscapes, in particular farmland, where such habitats are largely absent.	Insufficient scope to lead to recovery of all pollinator populations, though many rare and declining species likely to benefit
To reverse decline in pollinator populations	Screened in as directly relevant, feasible, and enforceable, including the roll out of EU wide pollinator monitoring.	Directly addresses target and includes establishment of EU wide monitoring programme to inform and improve targeting and actions

10.4 Impacts of assessed target options

A full quantitative assessment of the costs and benefits of reversing pollinator declines is not possible at this stage, because insufficient data are available to allow the type and extent of measures required to meet this target to be quantified across the EU. Furthermore, much of the action required for pollinators would be delivered through other costed targets for semi-natural habitats (steppe, heathland and scrub; forests; wetlands) as well as for grasslands and agro-ecosystems. It is important that the costs of these actions are not double counted, and the additional costs of measures needed to reverse pollinator declines may be modest. This section therefore includes an assessment of the specific costs of implementing a monitoring programme for pollinators, to complement measures costed for other ecosystems. The benefits of meeting pollinator targets are also discussed, and examples of their value are given.

Stakeholders likely to be impacted by the targets include:

- Landowners and managers including farmers, foresters, green space & protected area managers, other landowners including public authorities and private business. These land managers will bear costs of planning and carrying out habitat restoration and maintenance to benefit pollinators, but will also gain benefits (pollination, biological control of pests, improved image and public awareness and appreciation). Some management changes will decrease overall management costs (e.g. by reducing frequency of cutting/mowing and weed control activities, replacing management intensive horticultural/planted vegetation with native vegetation).
- Wider public – owners of gardens, users of green spaces. No additional costs expected & cultural and wellbeing benefits from changed management and reductions in pesticide use.
- Species experts and volunteer citizen scientists – benefit from paid work opportunities or opportunities for voluntary action.

Stakeholders who are likely to benefit from the targets include:

- Farmers and the whole biomass supply chain benefit from the sustainable provision of animal-pollinated crops and associated benefits of pollinators.
- Society and economy benefit from healthy ecosystems dependent on the diversity of wild animal-pollinated plants. The benefits are numerous ecosystem functions and services provided by those ecosystems, including resilience to climate change and provision of regulating services.
- Beekeepers (from the additional flower resources available).
- Owners of gardens, users of green spaces, and society will benefit from the non-market values of pollinators – cultural, aesthetic, wellbeing.
- Businesses and enterprises can benefit from enhanced reputation and biodiversity friendly status through their sustainability reporting, publicity, customer relations, as well as improving staff wellbeing through introducing more nature to premises.

Costs

Costs were estimated based on the costs of restoring Annex I habitats, the costs of the England farmland wildlife package for pollinators, and the costs of the EU pollinator monitoring scheme.

The ecosystem restoration costed in this impact assessment will contribute to reversing pollinator declines, especially the completion of all necessary restoration measures on 15,093 km2 of Annex I grasslands[83], 2096 km2 of Annex I heath and scrub[84], and up to 122,240 km2 of Annex I wetlands by 2030[85]. The costs of this restoration are not quantified for the pollinator target as they are not additional. The costs of actions for pollinators on intensively managed farmland are largely overlapping with actions for farmland birds. These are estimated at €436,866,785 - €686,578,412 to 2030 for scheme agreements on the minimum and maximum proportion of the agricultural area (min pasture = 13%, max = 23%. Min arable = 31%, max = 47%) that would be required to increase in the wildlife populations by 10% by 2030[86]. Each scheme agreement provides 10% of wildlife beneficial habitat (including agriculturally productive habitats) on the area covered by the agreement. See agroecosystem fiche for details.

Total additional costs to 2030 for pollinator monitoring are estimated at: €144.25 million (minimum monitoring) - €154 million (full monitoring)[87].

Additional costs to 2030 for restoration of pollinator habitat in forests, urban areas, and coasts could not be estimated.

Costs of reducing pressures could not be quantified but are mostly contained in the costs of implementing existing EU legislation. The baseline scenario assumes that pesticide pressures on

[83] 30% of estimated 47,909 km2 that would be in not good condition in 2030 in the baseline scenario plus at least 2,400 km2 that needs to be recreated (see agro-ecosystem fiche for details)

[84] 30% of estimated 6,586 km2 that would be in not good condition in 2030 in the baseline scenario plus at least 400 km2 that needs to be recreated (see heath and scrub fiche for details)

[85] 30% of estimated 40,800 km2 that would be in not good condition in 2030 in the baseline scenario (see wetlands fiche for details)

[86] On a total agro-ecosystem area of 2,096,616 km2 (according to Corine Land Cover data in 2018)

[87] Taken from EU PoMS proposal at https://ec.europa.eu/jrc/en/publication/proposal-eu-pollinator-monitoring-scheme

pollinators will decrease[88], that nitrogen deposition will continue to decline, and fertilizer use will decrease[89]. The invasive alien species regulation will increasingly catalyse action to prevent and control IAS that affect pollinators. However, in the absence of targeted policy drivers for pollinator conservation, progress is expected to be slow, and it is not possible with current knowledge to estimate whether this will have a significant influence on current rates of decline.

Table X-2: Other costs to meet target of restoring pollinator populations

Source: (Potts et al, 2020), agro-ecosystem assessment.[90]

Action	Total annual cost	Total over period
Minimum viable scheme for pollinator monitoring	€13.3 million per year	€133 million to 2030
Moth module	€1.1 million per year	€11 million to 2030
Rare and threatened species monitoring module	€250,000 to €1.0 million per year	€0.25-10 million to 2030
Total additional costs over 10 years		**€144.25-154 million to 2030**

Table X-3: Qualitative overview of benefits from pollinators

Benefit	Evidence of value	Potential to increase with restoration
Crop pollination	Pollination of almost all fruits, vegetables, herbs and nuts, oil crops (notably oilseed rape), pulses (beans, peas, lentils, etc), cotton, flax, feed and forage plants (notably all the protein rich and nitrogen-fixing legumes – beans, peas, clovers, alfalfa, vetches, lupins, etc). Crops grown for fibre or fuel: oilseed rape, cotton, flax, certain tree species, linseed, and other industrial crops. Crops grown for animal food, including beans, peas, alfalfa, lupins, sunflower, oilseed rape, used in feed for cattle, sheep, poultry and pigs, and farmed fish food. Medicinal herbs used in the food industry, including basil, sage, rosemary, thyme, coriander, cumin, dill, sage. Benefits for food security and associated benefits for human health.	High for most crops in response to targeted measures that reduce current deficits & meet increasing demand (potential trade-offs or interactions with fertiliser use and pesticide use).
Pollination of wild plants	Over 85% of non-crop plants rely on pollinating insects. Pollinators are therefore essential for the supply of most of the ecosystem services that rely on natural vegetation,	High for most species in response to restoration.

88 As a result of increasing organic farming area, future bans or withdrawals of active substances with particularly harmful effects, increased member state ambition in national action plans, and possibly a requirement for national reduction targets in a revised Sustainable Use of Pesticides Directive.

89 As a result of further progress under the national emissions ceiling directive and other policy drivers on nitrogen pollution, and the Farm to Fork Strategy target to reduce fertiliser use.

90 Potts et al., (2020) Proposal for an EU Pollinator Monitoring Scheme.

	particularly nutrient regulation from nitrogen-fixing plants (highly pollinator dependent). Wild plants supply fruits, seeds, shelter and other resources to wide range of other biodiversity including birds, mammals and insects. Also, many animal-pollinated wild plants are collected for their medicinal properties and used in the pharmaceutical industry. Significant associated benefits for ecosystem services derived from healthy plant communities, including, but not limited to provision of habitat for wildlife, soil fertility, water quality, flood regulation, and C sequestration.	
Natural biological control and decomposition of organic matter	Aphidophagous hoverfly larvae known to predate aphids on cereal crops, predatory wasps. Hoverfly larvae role in decomposer community. Evidence from scientific research.	Potential for increase in response to restoration and reduced pesticide use.
Cultural, aesthetic, spiritual benefits from pollinators	Prominence of bees, butterflies, and the larger and more conspicuous pollinator species in culture, art, people's appreciation of nature, etc. Pollinators are amongst the most visible and attractive manifestations of nature particularly in urban settings. Evidenced by size of public concern about pollinator decline (also present in public with low level of knowledge about nature), e.g. participation in national and EU public consultations and citizens initiatives.	Potentially huge significance of pollinators as 'flagships' of insect protection and visible attractive signs of nature particularly for urban populations.
Other socio-economic benefits	Benefits for recreation and tourism of restored habitats and pollinator species. Opportunities for employment and income from restoration works. Benefits for beekeepers from additional flowers available for honeybees	Increase in value directly connected to restoration actions.

Relative significance of benefits from pollinator populations

It is not possible to calculate the overall benefits provided by pollinators or the additional benefits of restoration of populations, but just the value of crop pollination greatly exceeds the costs of restoration, as estimated:

The monetary **benefit of crop pollination** by wild pollinators was estimated to be worth €4.517 billion in 2012.[91]

The overall benefits provided by wild pollinators are much larger than the crop pollination benefits that can be monetized, as the wider benefits derive from pollination of non-crop vegetation and the ecosystem services that provides, and the presence of the pollinators themselves.

[91] Vallecillo et al., (2018) Ecosystem services accounting Part I Outdoor recreation and crop pollination. JRC Technical Reports. Crop pollination by wild bees and honeybees across Europe was estimated at 14.6 [±3.3] billion EUR annually between 1991 and 2009 (Leonhardt et al, 2013). This corresponded to an average value of insect pollination of 6948 EUR per km2 of agricultural area.

10.5 Synthesis

The assessment has demonstrated that the additional costs associated with the pollinator target (monitoring and actions on intensively managed farmland) are much lower than the monetised benefits of crop pollination by wild pollinators, without taking account of the substantial additional benefits that cannot be monetised. These costs (€154M) are estimated at around 3% of the annual benefits of animal pollination (€4517M), though given the additional benefits this is likely to be <1%. It is not possible to say to what exact extent these benefits would be lost by 2030 if no action is taken, but the assessment shows that through the restoration of pollinator habitats it will be possible to mitigate a considerable loss.

The pollinator target is feasible, as well-established restoration actions are available, and measurable, as the work on a pollinator monitoring mechanism is already under way. The costs of action in agro-ecosystems are far below the monetary benefits obtained from crop pollination, without even fully accounting for all benefits provided by pollinators. It is currently not possible to calculate the costs of the necessary restoration action needed in forests, urban areas, and other ecosystems, due to the knowledge gaps, but most actions are either low-cost or cost saving (e.g. due to reduced management such as less frequent cutting of grassland areas) or are associated with adoption of management systems that bring other biodiversity benefits (coppicing, forest edge diversification, increasing native flowering plants).

Actions to reverse pollinator declines synergise with, add value to, and complement the restoration of agro-ecosystems, heath, and scrub, forests, wetlands, and urban green spaces. The pollinator target would go further than the ecosystem targets, because restoring habitat condition will not automatically deliver for pollinator populations, as 1) pollinators are very rarely monitored as an indicator of habitat condition, so habitats may reach good status in terms of vegetation composition but key pollinators are still absent (e.g. due to impacts of chemicals), and 2) pollinators require landscape scale habitat mosaics and combinations of different habitats that do not always result from restoration that is measured by improvement in condition of one habitat or ecosystem type.

Table X-4: Overview table assessing options on EU impact assessment criteria

	Habitats Directive pollinator species	Annex I habitats	Reverse decline in pollinator populations
Feasibility / effectiveness	Feasibility varies according to species and required habitat. Not effective at restoring pollinator populations as a whole (as Annex includes only a tiny proportion of all pollinators).	High feasibility and potential for restoration. Restoration is highly effective for biodiversity, and contributes to other ecosystem services, but will not deliver recovery of pollinator populations outside these habitats. Re-creation of new habitat is limited by the availability of suitable sites.	High feasibility (as measures already established under the CAP) and effective if measures are taken on 10% of all farmland

Efficiency	Targeted measures deliver population increases of most species; benefits for other pollinators limited to species in the same habitat.	Restoration of habitats important for pollinators benefits rare species and abundance of commoner species. But may not meet species requirements for landscape diversity.	Measures on farmland are generally low cost. Some opportunity cost on arable land of increases in grassland, legumes, and fallow in crop rotations.
Coherence	Full coherence with EU environmental policies as already an objective of the EU Habitats Directive to reach favourable conservation status.	Full coherence with EU environmental policies as already an objective of the EU Habitats Directive to reach favourable conservation status. Potential to also make contributions to other ecosystem services from grasslands, heaths etc.	Full coherence with EU environmental policies (as other options) and meets global obligations to protect pollinators.
Proportionality	Proportionate to the very high importance of the species for biodiversity conservation and as indicators of habitats of conservation value.	Proportionate to the high importance of the habitats for biodiversity and associated ecosystem services.	Proportionate to the benefits provided by pollinator populations.
Conclusions	**Not recommended as target**	**Not recommended as target**	**Include as a target, with high priority**

11. Cost estimates for different speeds of restoration

Table XI-1: Overview of cost estimates for targets options on the restoration, re-creation and maintenance of Annex I habitat (in MEUR)

Please note: 1) Figures are presented as Present Value of the sum of annual costs, discounted at an annual rate of 4%, which explains why scenario B comes out more costly in net terms since a bigger share of cost is borne in the short term. Caution should be taken, since nature restoration generally actually becomes more costly over time if postponed, which was not factored in the cost estimates; 2) Marine ecosystems, urban ecosystems, soil ecosystems and pollinators were not included in this table since no area-based targets to restore or re-create Annex I habitat were screened in (urban, soils), or only partly (marine). For marine it was not possible to make a reliable cost estimate due to data gaps both on the extent of measures required and costs; 3) Maintenance is included in the calculations to ensure no deterioration; 4) The grand totals are slightly lower than those in the summaries of the thematic IA's since the latter include maintenance costs up to 2070, in line with the requirement of no-deterioration until the cut-off date for this assessment.

Scenario A: 15-40-100 % by 2030-40-50

Target		Costs for 15 % by 2030 (present value, MEUR)	+Costs for 30 % by 2040 (present value, MEUR)	+Costs for 90 % by 2050 (present value, MEUR)	Total Costs for 15 % by 2030, 40 % by 2040, 100 % by 2050 (present value, MEUR)	Grand total Cost 2030-2050 (present value, MEUR)
Ecosystem	Cost Category					
Peatlands	Restoration	436	501	677	1 614	4 204
	Re-creation	103	118	160	381	
	Maintenance	959	742	508	2 209	
Marshlands	Restoration	58	68	90	216	2 931
	Re-creation	3	3	4	10	
	Maintenance	1 167	908	630	2 705	
Forests	Restoration	5 874	6 753	9 124	21 751	44 352
	Re-creation	187	214	290	691	
	Maintenance	9 532	7 352	5 026	21 910	
Heathland and scrub	Restoration	71	118	235	424	7 218
	Re-creation	25	30	34	89	
	Maintenance	2 066	2 309	2 330	6 705	
Grasslands	Restoration	1 080	1 241	1 677	3 998	22 346
	Re-creation	976	714	489	2 179	
	Maintenance	7 020	5 428	3 721	16 169	
Rivers, lakes and alluvial habitats	Restoration	8 236	9 468	12 793	30 497	34 082
	Re-creation	22	25	34	81	
	Maintenance	1 397	1 177	930	3 504	
Coastal wetlands	Restoration	1 145	1 317	1 780	4 242	4 974
	Re-creation	22	26	35	83	
	Maintenance	284	218	147	649	
TOTAL		**40 663**	**38 730**	**40 714**	**120 107**	

Average annual	4 518	3 873	4 071	

Scenario B: 30-60-100 % by 2030-40-50

Target						
Ecosystem	Cost Category	**Costs for 30 % by 2030 (present value, MEUR)**	**+Costs for 60 % by 2040 (present value, MEUR)**	**+Costs for 90 % by 2050 (present value, MEUR)**	**Total Costs for 30 % by 2030, 60 % by 2040, 90 % by 2050 (present value, MEUR)**	**Grand total Cost 2030-2050 (present value, MEUR)**
Peatlands	Restoration	872	601	406	1 880	4 543
	Re-creation	206	141	96	443	
	Maintenance	959	748	514	2 221	
Marshlands	Restoration	116	80	54	250	2 994
	Re-creation	5	4	3	12	
	Maintenance	1 167	923	642	2 732	
Forests	Restoration	11 748	8 104	5 474	25 326	53 476
	Re-creation	373	257	174	804	
	Maintenance	11 901	9 190	6 255	27 347	
Heathland and scrub	Restoration	141	141	141	423	7 247
	Re-creation	29	30	30	89	
	Maintenance	2 066	2 322	2 347	6 735	
Grasslands	Restoration	2 160	1 428	1 006	4 594	23 008
	Re-creation	987	715	485	2 186	

	Maintenance	7 020	5 476	3 731	16 227	
Rivers, lakes and alluvial habitats	Restoration	16 472	11 362	7 676	35 510	39 061
	Re-creation	22	15	10	47	
	Maintenance	1 397	1 177	930	3 504	
Coastal wetlands	Restoration	2 292	1 581	1 068	4 941	5 687
	Re-creation	45	31	21	97	
	Maintenance	284	218	147	649	
TOTAL		**60 262**	**44 544**	**31 210**	**136 016**	
Average annual		**6 696**	**4 454**	**3 121**		

Table XI-2 Benefit to cost ratios for Annex I habitat targets for Scenario A and B

Ecosystem type	Benefit to cost ratio (Costs for Scenario A: 15 % by 2030, 40 % by 2040, 100 % by 2050)	Benefit to cost ratio (Costs for Scenario B: 30 % by 2030, 60 % by 2040, 100 % by 2050)
Inland wetlands (for peatland only)	7.1 (2.2 if carbon only)	8.3 (2.5 if carbon only)
Forests	4.1 (0.1 if for carbon only*)	4.1 (0.1 if for carbon only*)
Heathland and scrub	7.9 (1.3 if carbon only)	9.2 (1.5 if carbon only)
Agro-ecosystems	8.6 (0.6 if carbon only)	9.2 (0,7 if carbon only)
Rivers, lakes and alluvial habitats	24	26
Coastal wetlands	35.3 (0.2 if carbon only)	38.1 (0.2 if carbon only)

Median cost-benefit ratio between ecosystem types	7.9	8.8

= most conservative estimate only based on reduced felling intensity (see section 3.4 above)

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PART 6/12

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

ANNEX VIII-a

Accompanying the

proposal for a Regulation of the European Parliament and of the Council

on nature restoration

{COM(2022) 304 final} - {SEC(2022) 256 final} - {SWD(2022) 168 final}

Annex VIII: Background information for potential restoration targets

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Annex VIII-a: WETLANDS

Introduction

This paper provides information derived from the Member States' reports and assessments under Article 17 of the Habitats Directive. It is a background information to help identify possible restoration targets for the 'legal binding instrument' under the EU Biodiversity Strategy to 2030.

The 'wetlands' group includes, 28 Annex I habitat types (see Table 1): all peatlands (71xx, 72xx, 73xx), several coastal wetlands and halophytic (salt) habitats, wet heaths, and wet forests (excluding alluvial and riparian forests[1]).

Table 1 – Wetland Annex I habitat types selected

Coastal and salt habitats (11 types)		**Mires, bogs and fens (12 types)**	
1130	Estuaries	7110	Active raised bogs
1140	Mudflats and sandflats not covered by seawater at low tide	7120	Degraded raised bogs still capable of natural regeneration
1150	Coastal lagoons	7130	Blanket bogs
1310	Salicornia and other annuals colonizing mud and sand	7140	Transition mires and quaking bogs
1320	Spartina swards (*Spartinion maritimae*)	7150	Depressions on peat substrates of the *Rhynchosporion*
1330	Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	7160	Fennoscandian mineral-rich springs and springfens
1340	Inland salt meadows	7210	Calcareous fens with Cladium mariscus and species of the *Caricion davallianae*
1410	Mediterranean salt meadows (*Juncetalia maritimi*)	7220	Petrifying springs with tufa formation (*Cratoneurion*)
1420	Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)	7230	Alkaline fens
1530	Pannonic salt steppes and salt marshes	7240	Alpine pioneer formations of the *Caricion bicoloris-atrofuscae*
1650	Boreal Baltic narrow inlets	7310	Aapa mires
Wet heaths and peat grassland (3 types)		7320	Palsa mires
4010	Northern Atlantic wet heaths with *Erica tetralix*	**Wet forests (2 types)**	
4020	Temperate Atlantic wet heaths with *Erica ciliaris* and *Erica tetralix*	9080	Fennoscandian deciduous swamp woods
6460	Peat grasslands of Troodos	91D0	Bog woodland

[1] These have been included in the group 'river, lake and alluvial/riparian habitats'.

Wetland coverage in the EU

The 28 habitat types selected cover close to **174 400 km²** (**4.5 %** of the EU terrestrial area[2]); this excludes areas reported by Romania, which are known to be largely overestimated[3].

The data available from Corine Land Cover[4] and from the Ecosystems Map of Europe[5] do not allow a straightforward comparison between the total area of wetlands in the EU and the area covered by Annex I wetlands. This is mainly due to the nomenclatures used and the spatial resolution of the datasets. A comparison between these data sources – excluding wet heaths and wet forests – is given in Table 2 below.

Table 2 – Wetland areas (km²) from different sources (EU27)

Corine Land Cover 2018 (level 3)

Inland & coastal wetlands, coastal waters	**85 809**
411 – Inland marshes	10 347
412 – Peat bogs	54 554
421 – Salt marshes	3 402
422 – Salines	539
423 – Intertidal flats	8 592
521 – Coastal lagunes	5 893
522 – Estuaries	2 482

Ecosystems map (level 3)

D - Mires, bogs and fens, marshes, estuaries and lagunes	**68 646**
D1 - Raised and blanket bogs	15 245
D2 - Valley mires, poor fens and transition mires	2 096
D3 - Aapa, palsa and polygon mires	37 766
D4 - Base-rich fens and calcareous spring mires	464
D5 - Sedge and reedbeds, normally without free-standing water	4 827
D6 - Inland saline and brackish marshes and reedbeds	717
X1 – Estuaries	2 282
X2 – Coastal lagunes	5 249

The largest areas of wetlands, particularly peatlands, occur in northern and central Europe (see Map 1). The Member States with the biggest areas of wetlands – and higher proportion – are Finland

[2] Area of habitats calculated from the area reported by Member States as 'best estimate' or 'average of minimum/maximum'
[3] The average total area of wetlands reported by Romania is 34 261 km²
[4] https://www.eea.europa.eu/data-and-maps/dashboards/land-cover-and-change-statistics
[5] https://www.eea.europa.eu/themes/biodiversity/mapping-europes-ecosystems

(15 %), Sweden (15 %), Denmark (15 %), Ireland (9 %), Estonia (8 %), and the Netherlands (6 %); most Member States have less than 1 % of their territory covered by Annex I wetland habitats.

Two Member States reported very small wetland areas – less than 1 km^2: Malta (0.3 km^2) and Luxembourg (0.1 km^2).

Table 3 gives the areas and proportion of wetlands for each Member State, including coverage by Natura 2000. Maps illustrating the distribution of different Annex I wetland habitats in the EU are available in Annex A.

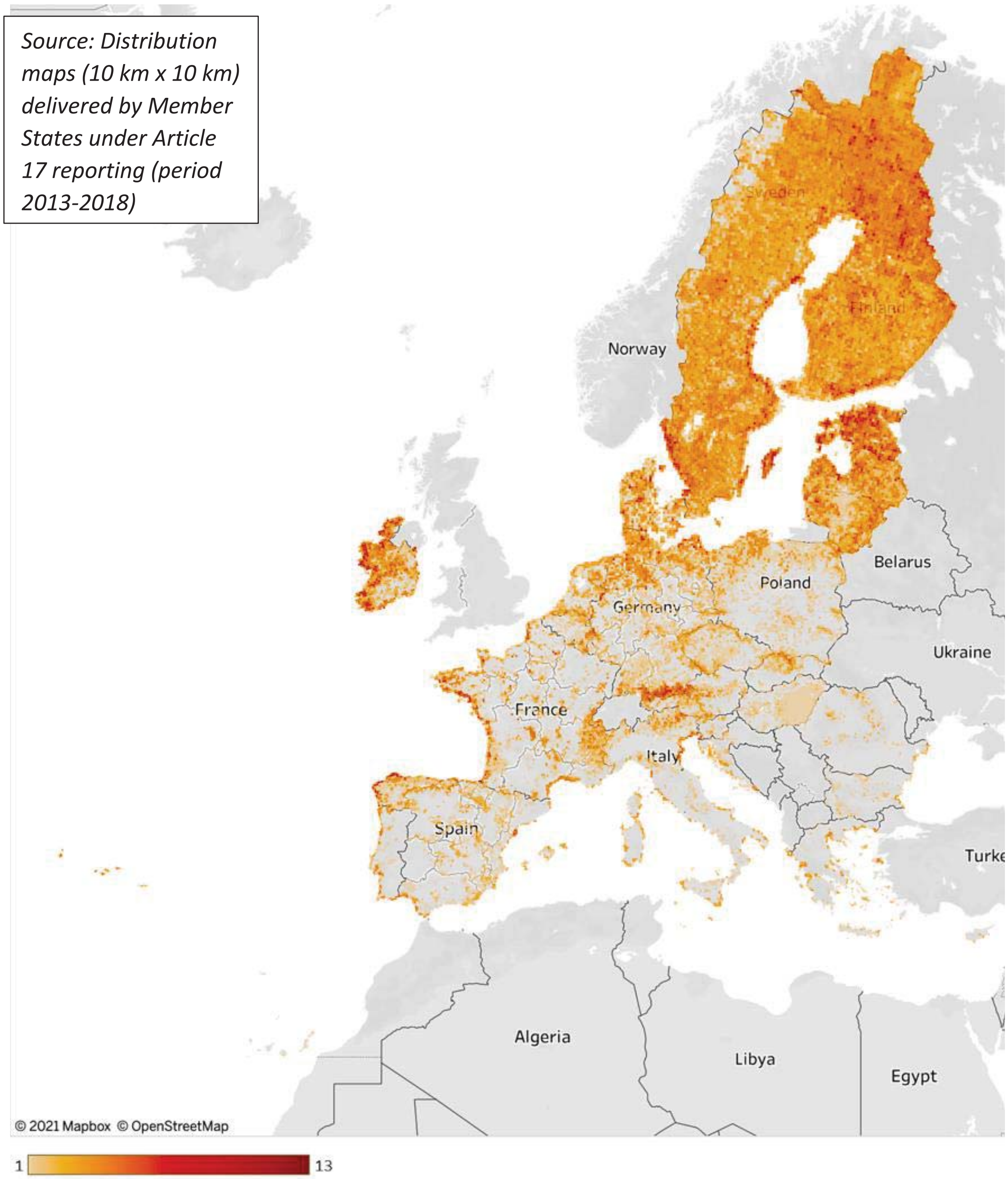
From the 174 400 km^2 of wetlands (excluding Romania), only **30 %** is estimated to be inside the Natura 2000 network (about **52 400 km^2**); this may be an underestimation since reports from Member States were not comprehensive on this regard. The coverage by Natura 2000 varies according to the wetland sub-group, **from 56 %** for 'coastal and salt habitats' **to 11 %** for 'wet forests'. The proportion of habitats per sub-group of wetlands and their coverage is detailed in Table 4.

Coverage by Natura 2000 also greatly varies according to the Member State: **from over 90 %** (Germany, Portugal[6], Cyprus and Slovenia) **to less than 25 %** (Austria, Denmark and Sweden) (Table 3).

The relatively low overall coverage of wetlands by Natura 2000 can also be explained by the fact that the Member States with the largest wetland areas (peatlands in particular) reported very low proportions in the network (Sweden = 11 %, Finland = 26 %). However, many Member States reported over 75 % of wetlands area inside Natura 2000 (Belgium, Bulgaria, Estonia, Germany, Hungary, Netherlands, Poland, Portugal and Slovenia).

[6] But there is an issue with the areas reported: coverage by Natura 2000 is 183 %

Map 1 – Distribution of the 28 Annex I wetland habitats in the EU



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell.

Table 3 – Area and proportion of wetlands per Member State

	Member State area (km²)	In the Member State		Proportion of the wetland area (%)	Inside Natura 2000	
		Wetland area (km²)	Wetland area (%)		Wetland area	% wetland area
Austria	83 944	181.8	0.2	0.10	64.9	35.7
Belgium	30 683	169.4	0.6	0.10	134.5	79.4
Bulgaria	110 995	117.2	0.1	0.07	89.4	76.3
Croatia	55 590	95.0	0.2	0.05	(5 896.2) (#)	100.0
Cyprus	9 249	6.9	0.1	0.00	5.1	74.1
Czechia	78 874	197.8	0.3	0.11	135.2	68.4
Denmark	44 162	6 402.8	14.5	3.67	1 536.7	24.0
Estonia	45 382	3 624.8	8.0	2.08	2 627.7	72.5
Finland	338 004	52 060.0	15.4	29.86	13 447.3	25.8
France	551 881	11 969.4	2.2	6.87	3 962.2	33.1
Germany	362 177	6 743.5	1.9	3.87	6 191.8	91.8
Greece	132 014	1 612.1	1.2	0.92	645.7	40.1
Hungary	93 012	2 415.6	2.6	1.39	2 163.1	89.5
Ireland	70 699	5 979.9	8.5	3.43	3 872.6	64.8
Italy	301 321	2 147.8	0.7	1.23	1 420.5	66.1
Latvia	64 590	2 394.7	3.7	1.37	1 157.0	48.3
Lithuania	65 289	1 689.5	2.6	0.97	1 046.6	61.9
Luxembourg	2 595	0.1	0.0	0.00	0.0	68.7
Malta	316	0.3	0.1	0.00	0.1	50.8
Netherlands	39 898	2 394.2	6.0	1.37	2 074.2	86.6
Poland	312 683	2 242.9	0.7	1.29	1 842.2	82.1
Portugal	92 378	691.2	0.7	0.40	1 264.6	183.0
Romania (*)	*238 404*	34 260.5	14.4		(1 793.8)	5.2
Slovakia	49 026	36.6	0.1	0.02	20.4	55.8
Slovenia	20 274	20.4	0.1	0.01	19.1	93.7
Spain	506 222	2 511.7	0.5	1.44	1 430.3	56.9
Sweden	450 110	68 647.0	15.3	39.37	7 288.6	10.6
Total	4 149 772	208 612.9	5.0		54 233.6	26.0
Total (without Romania)	**3 911 772**	**174 352.5**	**4.5**		**52 439.8**	**30.1**

Notes: Member States with more than 4.5 % (the EU average) of their terrestrial area covered by wetlands are highlighted; (*) areas reported by Romania are overestimated; (#) area of a few

Source: European Environment Agency – April 2021

habitats inside Natura 2000 clearly wrong (e.g., 1140 = 5 896.2 km^2), therefore, this value was excluded.

Table 4 – Area and proportion of wetlands per sub-group

		Inside Natura 2000	
EU27 excluding Romania	**Area (km^2)**	**Wetland area (km^2)**	**% wetland area**
Coastal and salt habitats	**37 780**	**20 967**	**56**
1130	7 505	3 581	48
1140	13 620	7 067(#)	52
1150	10 052	4 420	44
1310	433	498	100(*)
1320	159	265	100(*)
1330	1 119	947	85
1340	38	27	72
1410	813	866	100(*)
1420	867	906	100(*)
1530	2 505	2 246	90
1650	670	145	22
Wet heaths	**3 828**	**2 004**	**52**
4010	2 651	1 518	57
4020	1 177	486	41
6460	0.02	0.02	100
Bogs, mires and fens	**86 738**	**24 180**	**28**
7110	8 086	3 682	46
7120	1 162	660	57
7130	2 817	1 781	63
7140	31 674	4 141	13
7150	219	152	70
7160	96	27	28
7210	656	378	58
7220	814	70	9
7230	4 691	1 328	28
7240	78	69	89
7310	36 020	11 376	32
7320	425	516	122
Wet forests	**46 006**	**5 289**	**11**
9080	1 422	633	45
91D0	44 585	4 657	10

TOTAL	**174 352**	**52 440**	**23**

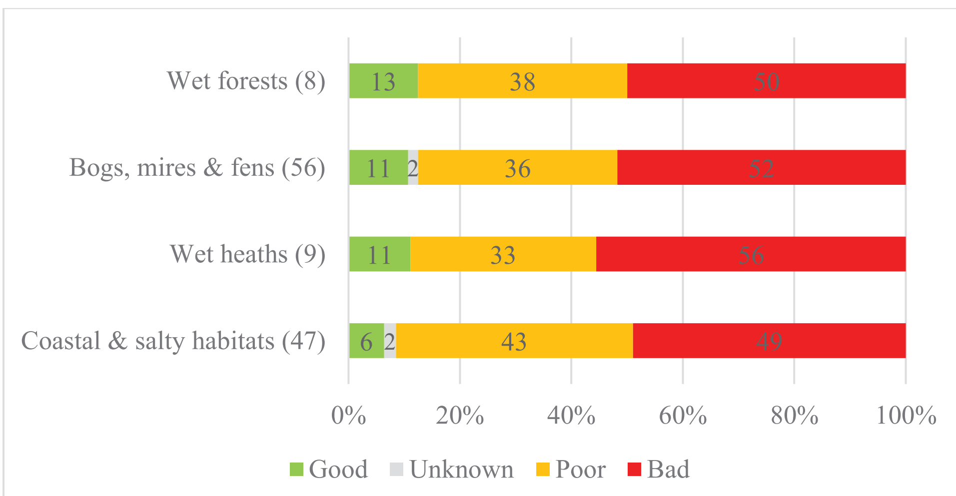
Note: (#) does not include the wrong value (5 800 km2) reported by Croatia; (*) percentage over 100 % due to inconsistencies in data reported

Conservation status and trends

The vast majority (**89 %** of assessments) of the 28 wetland habitats at the EU level have an **unfavourable** conservation status (38 % poor and 51 % bad). Only **9 %** have a **good** conservation status. There are some differences between the different habitat groups (Figure 1): 'wet forests' has the highest proportion of good status (13 %) and the 'coastal and salty habitats' the worst status (92 % unfavourable).

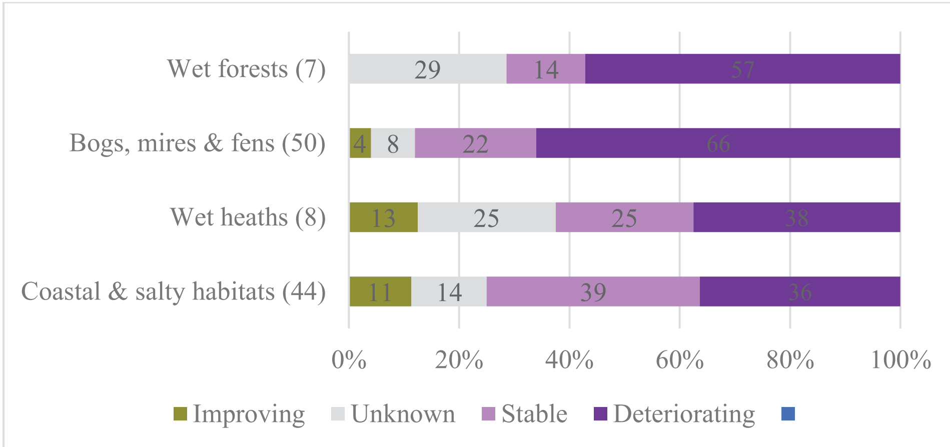
Among the wetland habitat assessments that do not have a good status, more than half have a **deteriorating** trend (**51 %**) while only **7 %** have an improving trend. An additional **28 %** maintain their unfavourable status; the conservation status trend is unknow for **13 %** of the assessments. The wetland group with the worst conservation status trends are **'bogs, mires and fens'** (**66 % deteriorating**); **'wet heaths'** have the higher proportion of **improving** trends (**13** %) (Figure 2).

Figure 1 – Conservation status at the EU level per wetland type (in percentage)



Note: Number of assessments per group shown in brackets.

Figure 2 – Conservation status trends at the EU level per wetland type (in percentage)



Note: Number of assessments/habitats per region shown in brackets.

Details on conservation status and conservation status trends for each Member State are given in Table 5.

Table 5 – Conservation status and trends of wetland habitats in the Member States (in percentage)

Member State	FV	U1-	U1+	U1=	U1x	U2-	U2+	U2=	U2x	XX
AT (19)		5		21		21		11	42	
BE (21)	5	5					29	43	19	
BG (20)	5		10	40	45					
CY (3)						100				
CZ (12)	8	8		33		50				
DE (40)	25	18		20		23		13	3	
DK (30)	7	7		3	3	33	7	20	20	
EE (14)	50		7	29		7		7		
ES (36)	3	25		28	11	11			8	14
FI (22)	36	18	5			14		18	5	5
FR (52)	2	12	2	27	17	17		6	13	4
GR (11)	18	9	9	45		9				9
HR (18)				28	11	22		17		22
HU (6)	17			33		50				
IE (17)	12	29		6		47		6		
IT (31)	10	10	6	26	3	23	6	10	3	3
LT (12)	25				33	8			33	
LU (3)						67		33		
LV (13)	8		8	46	8	8			23	
MT (4)				25				75		

NL (14)			21	21		36	7	14		
PL (21)	5	14	5	24	10	19		14	5	5
PT (29)	14	34		10		28		10		3
RO (25)	40	16		32	4	4		4		
SE (40)	23	10		15		28		20	5	
SI (19)	37	16		26		11		11		
SK (12)		8		25	33	25		8		

Notes: FV = good, U1 = poor, U2 = bad, XX = unknown conservation status '-' = deteriorating, '+' = improving, '=' = stable, 'x' = unknown conservation status trend; number of assessments per Member State shown in brackets.

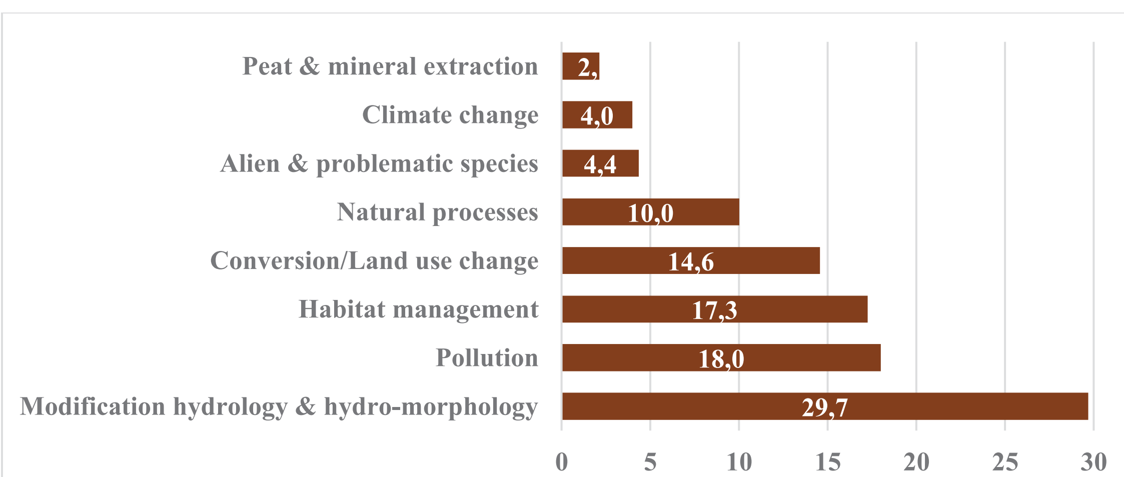
Pressures

Wetland habitats are subject to a wide diversity of pressures resulting in their degradation and extirpation. According to Member States reports under Article 17 of the Habitats Directive, the top three groups of pressures (in percentage of the total) are:

- **Modification of hydrology and hydro-morphology** with close to **28 %** of all pressures; this includes e.g., drainage, water abstraction and dams
- **Pollution** from different origins with **18 %**; from these, near half is originated from agriculture and forestry activities, about 13 % from residential, industrial and recreational activities and over 37 % from mixed sources
- **Habitat management**, with over **17 %**; these include inadequate agricultural practices like under or overgrazing, mowing, harvesting (65 %), forestry like logging and burning (15 %) and fish and shellfish activities (17 %).

Equally important is the group '**conversion and land use change**' with near **15 %** of all reported pressures; this includes conversion of wetlands to other land uses (about 45 %) and development of infrastructure (near 55 %).

Figure 3 – Pressures reported for wetlands habitats (in percentage)



Source: European Environment Agency – April 2021

Note: based on pressures reported as 'high-ranking'

Condition of habitats

Member States reported on the condition of habitat types under Article 17 of the Habitats Directive. This data can be used to estimate the area of wetlands assessed as degraded (condition not-good) therefore, requiring restoration.

The area of wetland habitats that would need to be restored, i.e., improved condition, is **at least 27 100 km^2**, representing **16 %** of the total wetland area reported (the values exclude Romania). However, the condition of habitats reported as 'unknown' (or not reported) is almost 84 300 km^2 (48 % of the total area). This means that the area requiring restoration is much bigger than 27 100 km^2; for example, assuming that half of the 'unknown' area is in a not-good condition, the area to be restored would be over 69 200 km^2 or 111 400 km^2 if all the 'unknown' is assumed to be in a 'not-good' condition (64 % of the total wetland area). Table 6 gives information for each of the 28 wetland habitats (excluding Romania) and Table 7 the condition areas and percentage for each of the Member States.

In addition to the habitat condition, Member States also reported on the 'favourable reference areas'[7]. Comparing this area with the actual habitat area allows to estimate how much area of the habitat would need to be re-created to achieve a good distribution and area of the habitat. Based on this data, it is estimated that a **strict minimum** of **3 100 km^2** would need to be **re-created** to achieve a ‘favourable area’:

- 271 km^2 of coastal and salty habitats
- 170 km^2 of wet heaths
- 1 716 km^2 of bogs, mires and fens
- 973 km^2 of wet forests

However, these values are much higher since several Member States did not provide enough information in their reports to allow a more realistic estimation.

[7] The surface area in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the habitat type; this should include necessary areas for restoration or development for those habitat types for which the present coverage is not sufficient to ensure long-term viability

Table 6 – Condition of wetlands per Annex I habitat type

		Condition (area in km2)			Condition (in percentage)		
	Habitat area	**Good**	**Not-good**	**Unknown**	**Good**	**Not-good**	**Unknown**
Wetlands	**174 352.5**	**62 950.6**	**27 123.6**	**84 278.2**	**36**	**16**	**48**
Coastal and salt habitats	**37 780.0**	**10 494.8**	**7 896.9**	**19 388.3**	**28**	**21**	**51**
1130	7 504.6	958.2	2 673.0	3 873.4	13	36	52
1140	13 619.8	4 650.1	1 148.0	7 821.6	34	8	57
1150	10 052.4	1 347.7	2 496.6	6 208.1	13	25	62
1310	433.3	355.2	30.6	47.4	82	7	11
1320	159.0	120.1	25.9	12.9	76	16	8
1330	1 118.7	684.0	390.6	44.1	61	35	4
1340	37.5	11.9	6.9	18.7	32	18	50
1410	812.8	159.8	85.7	567.3	20	11	70
1420	866.4	561.8	133.3	171.4	65	15	20
1530	2 505.4	1 573.5	608.7	323.3	63	24	13
1650	670.0	72.5	297.5	300.0	11	44	45
Wet heaths	**3 828.4**	**857.9**	**1 564.5**	**1 405.9**	**22**	**41**	**37**
4010	2 651.4	521.8	1 526.2	603.4	20	58	23
4020	1 176.9	336.2	38.3	802.5	29	3	68
6460	0.02	0.02	0.00	0.00	100	0	0
Bogs, mires and fens	**86 738.1**	**47 556.2**	**9 330.8**	**29 851.0**	**55**	**11**	**34**
7110	8 086.2	2 481.0	926.4	4 678.7	31	11	58
7120	1 161.7	289.8	537.8	334.0	25	46	29
7130	2 817.0	1 468.4	1 325.0	23.5	52	47	1
7140	31 674.4	25 001.3	3 553.6	3 119.5	79	11	10
7150	218.9	125.5	41.9	51.5	57	19	24
7160	95.8	47.9	33.0	15.0	50	34	16
7210	656.5	406.5	188.9	61.1	62	29	9
7220	813.9	45.2	21.5	747.3	6	3	92
7230	4 691.3	2 577.1	789.7	1 324.6	55	17	28
7240	77.7	60.1	13.8	3.9	77	18	5
7310	36 020.0	14 980.0	1 548.0	19 492.0	42	4	54
7320	424.7	73.5	351.2	0.0	17	83	0
Wet forests	**46 006.1**	**4 041.7**	**8 331.4**	**33 632.9**	**9**	**18**	**73**
9080	1 421.5	371.4	270.5	779.6	26	19	55
91D0	44 584.6	3 670.3	8 060.9	32 853.3	8	18	74

Source: European Environment Agency – April 2021

Notes: Areas reported by Romania excluded from the table.

Table 7 – Condition of Annex I wetlands per Member State

	Wetland area (km²)				Percentage		
Member State	**Total**	**Good**	**Not-good**	**Unknown**	**Good**	**Not-good**	**Unknown**
AT	181.8	41.5	26.8	113.5	23	15	62
BE	169.4	8.9	17.1	143.5	5	10	85
BG	117.2	0.0	0.0	117.1	0	0	100
CY	6.9	4.3	2.7	0.0	62	39	0
CZ	197.8	153.4	17.1	27.3	78	9	14
DE	6 743.5	4 103.7	1 773.1	866.6	61	26	13
DK	6 402.8	289.7	1 382.0	4 731.1	5	22	74
EE	3 624.8	2 813.4	464.2	347.2	78	13	10
ES	2 511.7	390.0	481.5	1 640.1	16	19	65
FI	52 060.0	3 301.7	8 413.2	40 345.1	6	16	77
FR	11 969.4	2 069.1	787.6	9 112.6	17	7	76
GR	1 612.1	278.6	260.5	1 073.1	17	16	67
HR	95.0	6.0	0.2	88.8	6	0	93
HU	2 415.6	1 570.3	602.9	242.4	65	25	10
IE	5 979.9	2 453.1	3 526.8	0.0	41	59	0
IT	2 147.8	1 106.2	191.4	850.2	52	9	40
LT	1 689.5	524.7	77.0	1 087.8	31	5	64
LU	0.1	0.0	0.0	0.1	0	16	84
LV	2 394.7	1 166.4	366.8	861.5	49	15	36
MT	0.3	0.1	0.2	0.0	31	73	-4
NL	2 394.2	119.0	559.9	1 715.3	5	23	72
PL	2 242.9	543.5	1 702.3	-2.9	24	76	0
PT	691.2	215.2	338.2	137.9	31	49	20
RO (*)	34 260.5	26 001.9	2 250.5	6 008.0	76	7	18
SE	68 647.0	41 768.8	6 125.2	20 753.1	61	9	30
SI	20.4	16.5	3.4	0.4	81	17	2
SK	36.6	6.8	3.4	26.4	19	9	72

(*) areas reported by Romania largely overestimated

Source: European Environment Agency – April 2021

Carbon stock and sequestration

Literature on carbon stock and sequestration rates of wetlands is rather diverse and numbers for the individual habitats widely vary across the different studies. However, for many habitats values could still only be attributed by expert assessment.

Coastal and salty habitats listed in Annex I are reported to have high carbon sequestration rates but are relatively low in carbon storage. Covering less than 22% of the wetland area their share to the sequestration potential is about 45%. The contribution to the carbon stocks is less than 5%.

Wet heaths, bogs, mires, fens and wet forests are characterized by relatively low sequestration rates as productivity of the vegetation in wetlands is often relatively low. In contrast, carbon storage is usually very high as they are mostly characterized by peat soils which are very rich in organic soil carbon. In Europe, agriculture on drained peat soils is responsible for a large part of the total greenhouse gas emissions from agriculture. In the EU27, – where peat soils cover more than 3 % of the agricultural area – these peat soils contribute 25 % to the annual greenhouse gas emissions associated with agricultural land use. Member States reported under the LULUCF Regulation that managed wetlands (mostly on peat soils) are net sources of CO_2, with increasing emissions to the atmosphere by 5 % between 2000 and 2012.

Despite carbon sequestration rates of most peatland habitats reach only 50 % or less compared to forests (<1.5 tC/ha*yr compared to ca 2.6 tC/ha*yr), carbon stocks in peatland habitats are twice that high (260 t/ha compared to 130 t/ha) as they continuously accumulate carbon over centuries. The area of peatlands reported under Annex I of the Habitat Directive covers almost 137 000 km^2. The respective potential annual carbon sequestration rate would be around 10.25 Mio tonnes equivalent to about 38 Mio tons of CO_2, but only if habitats are in good condition. In principle, coastal and salty habitats would contribute another 30 Mio tons of CO_2-equivalent but currently available data indicates that most of this carbon is not stored in the respective habitats.

Overall, the carbon storage potential of wetland habitats is estimated between 1.6 Gt and 4.7 Gt of carbon, if habitats are in good condition (Table 8).

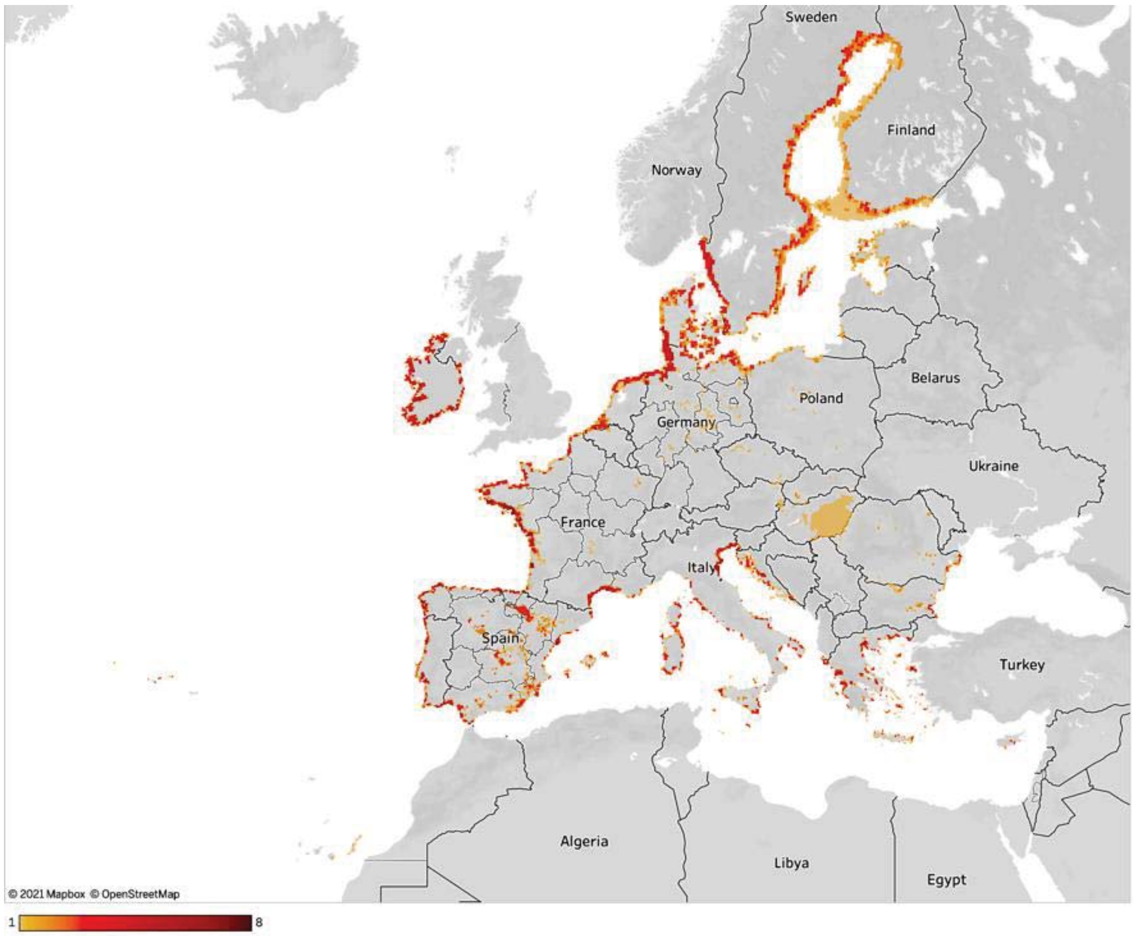
Table 8 – Carbon stock and sequestration of Annex I wetlands

EU27 excluding Romania	Wetland area (km^2)	Total Carbon Stock (Mt)		Potential carbon sequestration rate ($Mt\ y^{-1}$)
	EU27	min	max	mean
Coastal and salt habitats	**37 780**	**0.00**	**283.35**	**8.37**
1130	7 505	0.00	56.28	1.69
1140	13 620	0.00	102.15	3.06
1150	10 052	0.00	75.39	2.26
1310	433	0.00	3.25	0.13
1320	159	0.00	1.19	0.05
1330	1 119	0.00	8.39	0.34
1340	38	0.00	0.28	0.01
1410	813	0.00	6.10	0.24
1420	867	0.00	6.50	0.06
1530	2 505	0.00	18.79	0.38
1650	670	0.00	5.03	0.15
Wet heaths and peat grasland	**3 828**	**28.71**	**173.60**	**0.87**
4010	2 651	19.88	39.77	0.20
4020	1 177	8.83	17.66	0.09
6460	0.02	0.00	116.18	0.58
Bogs. mires and fens	**86 738**	**917.77**	**2 490.80**	**6.51**
7110	8 086	60.65	181.94	0.61
7120	1 162	8.72	26.15	0.09
7130	2 817	21.13	63.38	0.21
7140	31 674	237.56	712.67	2.38
7150	219	1.64	8.21	0.02
7160	96	0.72	3.60	0.01
7210	656	4.92	14.76	0.05
7220	814	0.00	6.11	0.06
7230	4 691	35.18	105.55	0.35
7240	78	0.59	1.76	0.01
7310	36 020	540.30	1 350.75	2.70
7320	425	6.38	15.94	0.03
Wet forests	**46 006**	**690.11**	**1 725.26**	**3.45**
9080	1 422	21.33	53.33	0.11
91D0	44 585	668.78	1 671.94	3.34
TOTAL	**174 352**	**1 636.58**	**4 673.01**	**19.19**

Note: areas reported by Romania note included

Annex A

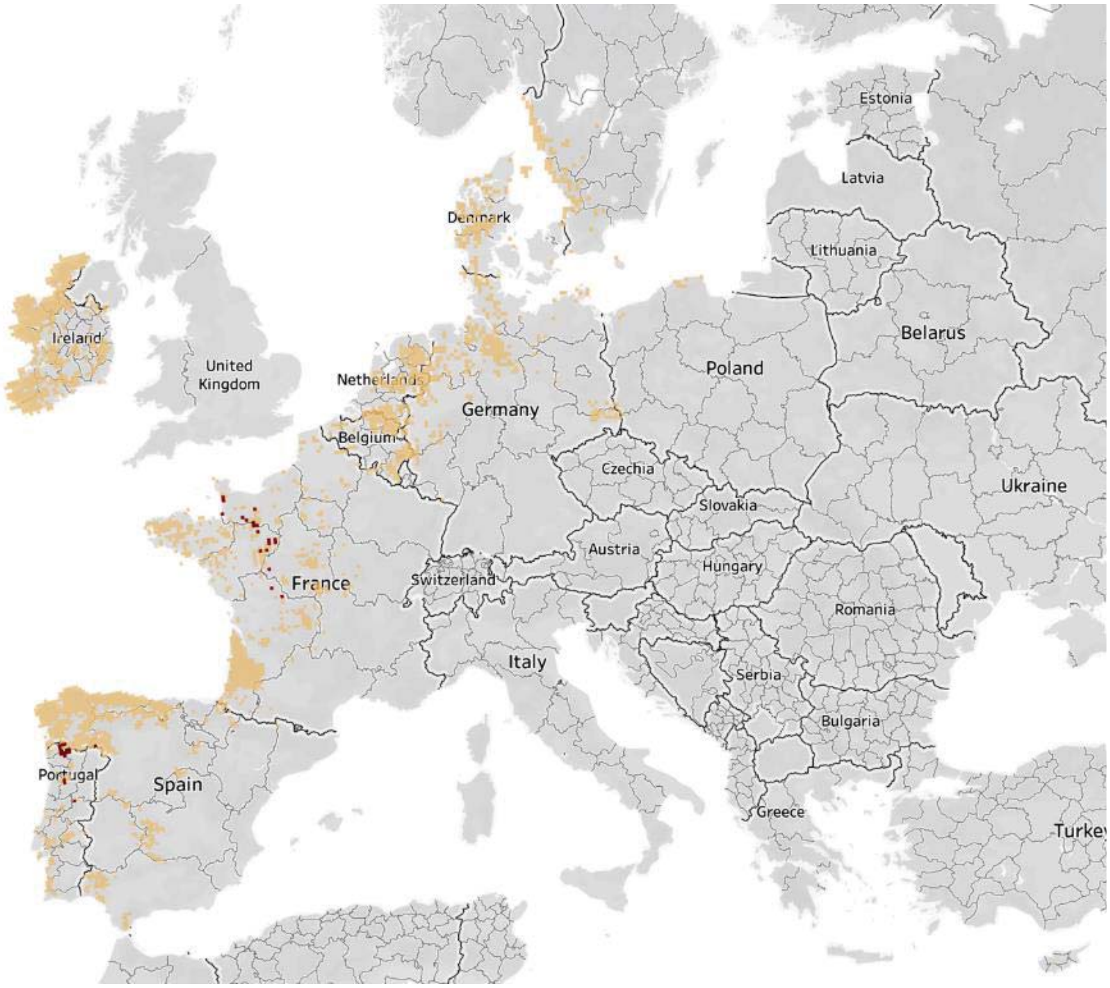
Map 2 – Distribution of Annex I coastal and salt habitats (1130, 1140, 1150, 1310, 1320, 1330, 1340, 1410, 1420, 1530, 1650)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell.

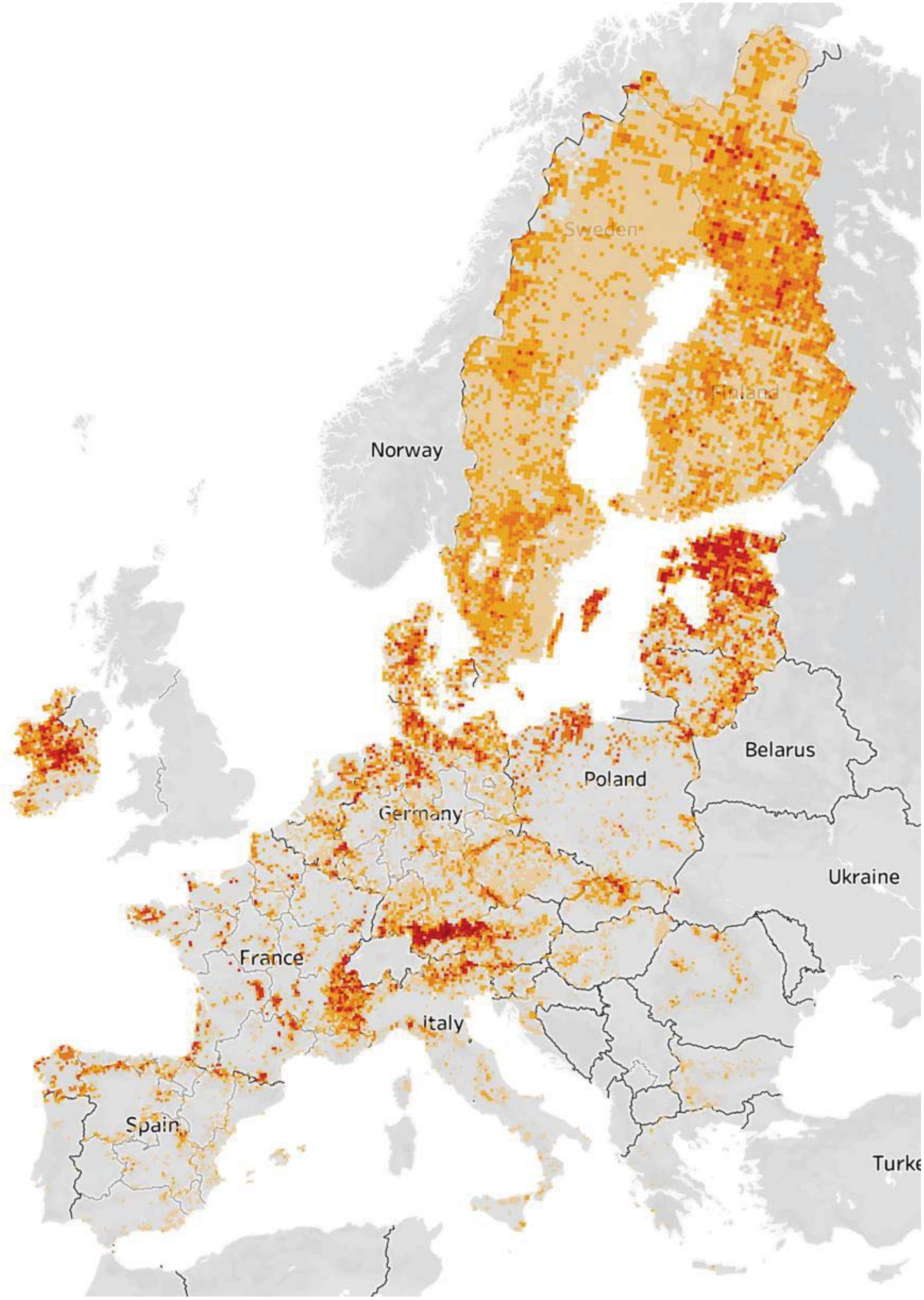
Source: European Environment Agency – April 2021

Map 3 – Distribution of Annex I wet heaths (4010, 4020) and peat grassland (6460)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell. Macaronesian islands not shown in the map.

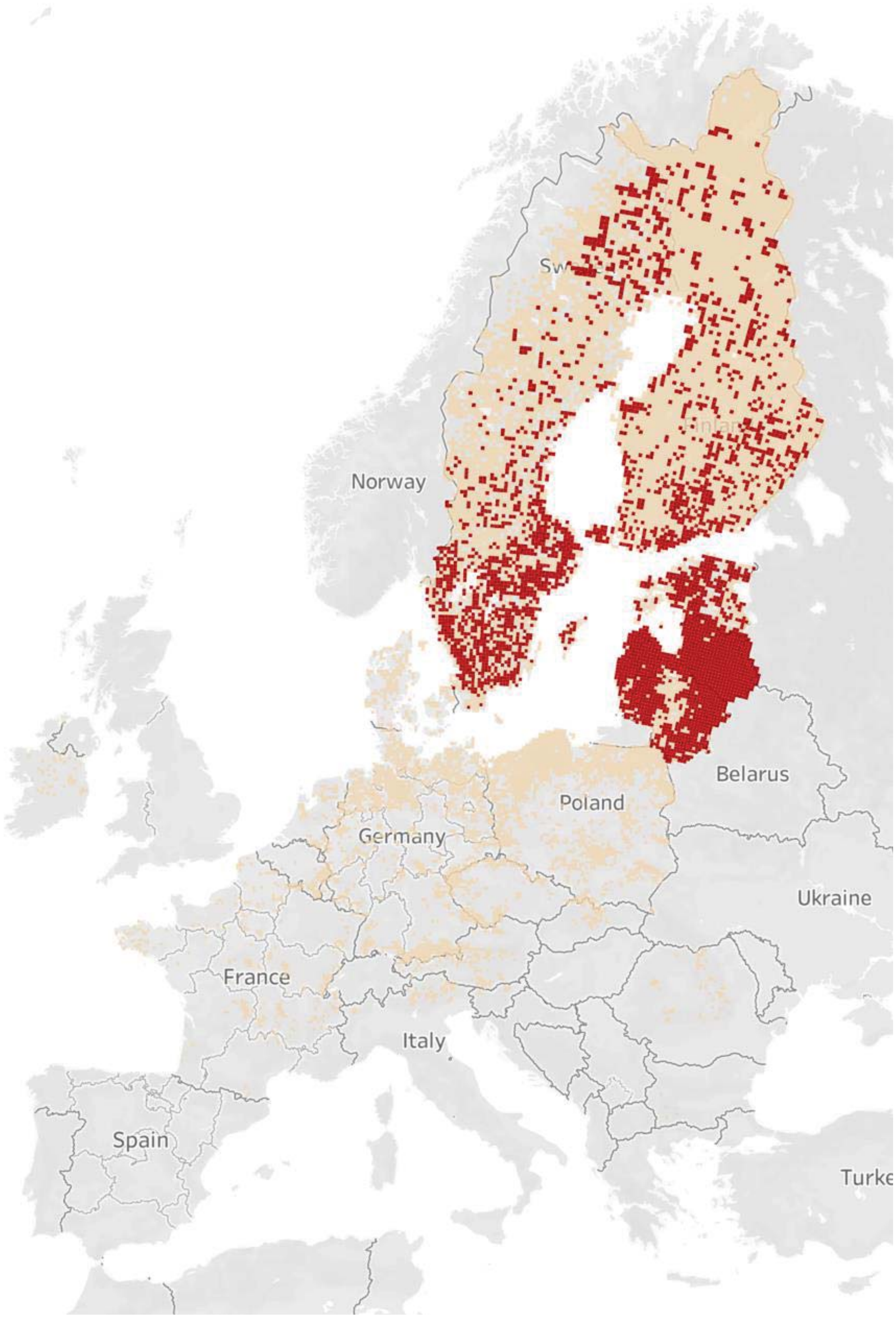
Map 4 – Distribution of Annex I bogs, mires and fens (7110, 7120, 7130, 7140, 7150, 7160, 7210, 7220, 7230, 7240, 7310, 7320)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell. Macaronesian islands not shown in the map.

Source: European Environment Agency – April 2021

Map 5 – Distribution of Annex I wet forests (9080, 91D0)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell. Macaronesian islands not shown in the map.

Source: European Environment Agency – April 2021

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PART 7/12

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

ANNEX VIII-b

Accompanying the

proposal for a Regulation of the European Parliament and of the Council

on nature restoration

{COM(2022) 304 final} - {SEC(2022) 256 final} - {SWD(2022) 168 final}

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Annex VIII-b: FORESTS

Introduction

This paper provides information derived from the Member States' reports and assessments under Article 17 of the Habitats Directive. It is a background information to help identify possible restoration targets for the 'legal binding instrument' under the EU Biodiversity Strategy to 2030.

The 'forests' group includes, 69 Annex I habitat types (see Table 1): all forests with codes 9xxx (except wet/alluvial/riparian forests and wooded meadows, which were included in other groups).

The Habitats Directive defines Annex I forest habitats as: *(Sub)natural woodland vegetation comprising native species forming forests of tall trees, with typical undergrowth, and meeting the following criteria: rare or residual, and / or hosting species of Community interest*. The Interpretation Manual of EU Habitats[1] list the following additional criteria:

- *forests of native species;*
- *forests with a high degree of naturalness;*
- *forests of tall trees and high forest;*
- *presence of old and dead trees;*
- *forests with a substantial area;*
- *forests having benefited from continuous sustainable management over a significant period.*

Table 1 – Forest Annex I habitat types selected

Boreal forests (6 types)		**Temperate forests (cont.)**	
9010	Western Taïga	91AA	Eastern white oak woods
9020	Fennoscandian hemiboreal natural old broad-leaved deciduous forests (*Quercus*, *Tilia*, *Acer*, *Fraxinus* or *Ulmus*) rich in epiphytes	91BA	Moesian silver fir forests
9030	Natural forests of primary succession stages of landupheaval coast	91CA	Rhodopide and Balkan Range Scots pine forests
9040	Nordic subalpine/subarctic forests with *Betula pubescens* ssp. *czerepanovii*	**Mediterranean and Macaronesian forests (18 types)**	
9050	Fennoscandian herb-rich forests with *Picea abies*	9210	Apeninne beech forests with *Taxus* and *Ilex*
9060	Coniferous forests on, or connected to, glaciofluvial eskers	9220	Apennine beech forests with *Abies alba* and beech forests with *Abies nebrodensis*
Temperate forests (32 types)		9230	Galicio-Portuguese oak woods with *Quercus robur* and *Quercus pyrenaica*

[1] https://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf

9110	*Luzulo-Fagetum* beech forests	9240	*Quercus faginea* and *Quercus canariensis* Iberian woods
9120	Atlantic acidophilous beech forests with *Ilex* and sometimes also *Taxus* in the shrublayer (*Quercion robori-petraeae* or *Ilici-Fagenion*)	9250	*Quercus trojana* woods
9130	*Asperulo-Fagetum* beech forests	9260	*Castanea sativa* woods
9140	Medio-European subalpine beech woods with *Acer* and *Rumex arifolius*	9270	Hellenic beech forests with *Abies borisii-regis*
9150	Medio-European limestone beech forests of the *Cephalanthero-Fagion*	9280	*Quercus frainetto* woods
9170	*Galio-Carpinetum* oak-hornbeam forests	9290	Cupressus forests (*Acero-Cupression*)
9180	*Tilio-Acerion* forests of slopes, screes and ravines	9310	Aegean *Quercus brachyphylla* woods
9190	Old acidophilous oak woods with *Quercus robur* on sandy plains	9320	*Olea* and *Ceratonia* forests
91A0	Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles	9330	*Quercus suber* forests
91B0	Thermophilous *Fraxinus angustifolia* woods	9340	*Quercus ilex* and *Quercus rotundifolia* forests
91C0	Caledonian forest	9350	*Quercus macrolepis* forests
91G0	Pannonic woods with *Quercus petraea* and *Carpinus betulus*	9360	Macaronesian laurel forests (*Laurus*, *Ocotea*)
91H0	Pannonian woods with *Quercus pubescens*	9380	Forests of *Ilex aquifolium*
91I0	Euro-Siberian steppic woods with *Quercus* spp.	9390	Scrub and low forest vegetation with *Quercus alnifolia*
91J0	*Taxus baccata* woods of the British Isles	93A0	Woodlands with *Quercus infectoria* (*Anagyro foetidae-Quercetum infectoriae*)
91K0	Illyrian *Fagus sylvatica* forests (*Aremonio-Fagion*)	**Mountainous coniferous forests (13 types)**	
91L0	Illyrian oak-hornbeam forests (*Erythronio-Carpinion*)	9410	Acidophilous *Picea* forests of the montane to alpine levels (*Vaccinio-Piceetea*)
91M0	Pannonian-Balkanic turkey oak –sessile oak forests	9420	Alpine *Larix decidua* and/or *Pinus cembra* forests
91P0	Holy Cross fir forest (*Abietetum polonicum*)	9430	Subalpine and montane *Pinus uncinata* forests (* if on gypsum or limestone)
91Q0	Western Carpathian calcicolous Pinus sylvestris forests	9510	Southern Apennine Abies alba forests
91R0	Dinaric dolomite Scots pine forests (*Genisto januensis-Pinetum*)	9520	*Abies pinsapo* forests
91S0	Western Pontic beech forests	9530	(Sub-) Mediterranean pine forests with endemic black pines
91T0	Central European lichen Scots pine forests	9540	Mediterranean pine forests with endemic Mesogean pines
91U0	Sarmatic steppe pine forest	9550	Canarian endemic pine forests
91V0	Dacian Beech forests (*Symphyto-Fagion*)	9560	Endemic forests with *Juniperus* spp.
91W0	Moesian beech forests	9570	*Tetraclinis articulata* forests

Source: European Environment Agency – April 2021

91X0	Dobrogean beech forests	9580	Mediterranean *Taxus baccata* woods
91Y0	Dacian oak & hornbeam forests	9590	Cedrus brevifolia forests (*Cedrosetum brevifoliae*)
91Z0	Moesian silver lime woods	95A0	High oro-Mediterranean pine forests

Forest habitats coverage in the EU

The 69 habitat types selected cover close to **357 952 km²** (**9.2 %** of the EU terrestrial area[2]); this excludes areas reported by Romania, which are known to be largely overestimated[3].

The data available from Corine Land Cover[4] and from the Ecosystems Map of Europe[5] do not allow a straightforward comparison between the total area of forests in the EU and the area covered by Annex I forests. This is mainly due to the nomenclatures used and the spatial resolution of the datasets. A comparison between these data sources – excluding alluvial and riparian forests – is given in Table 2 below.

Table 2 – Forest areas (km²) from different sources (EU27)

Corine Land Cover 2018 (level 3)

Forests	**1 356 423**
311 – Broad-leaved forest	435 974
312 – Coniferous forest	660 642
313 – Mixed forest	259 807

Ecosystems map (level 3)

G – Woodland, forest and other wooded land	**1 770 997**
G1 – Broad-leaved deciduous woodland	682 357
G2 – Broad-leaved evergreen woodland	52 200
G3 – Coniferous woodland	707 302
G4 – Mixed deciduous and coniferous woodland	236 096
G5 – Lines of trees, small anthropogenic woodlands, recently felled woodland, early-stage woodland and coppice	93 042

The areas of Annex I forests, have a good representation in most EU countries (except Ireland, Malta and the Netherlands) (see Map 1). The Member States with the highest proportion of those habitats are Slovenia (33 %), Croatia (24 %), Bulgaria (23 %), Greece (22 %), Cyprus (16 %), Austria (15 %), Italy (14 %), Slovakia (14 %), Spain (11 %), France (11 %) and Luxembourg (10 %); seven Member States have less than 2 % of their territory covered by forest Annex I habitats.

[2] Area of habitats calculated from the area reported by Member States as 'best estimate' or 'average of minimum/maximum'

[3] The average total area of forest habitats reported by Romania is 59 126 km²

[4] https://www.eea.europa.eu/data-and-maps/dashboards/land-cover-and-change-statistics

[5] https://www.eea.europa.eu/themes/biodiversity/mapping-europes-ecosystems

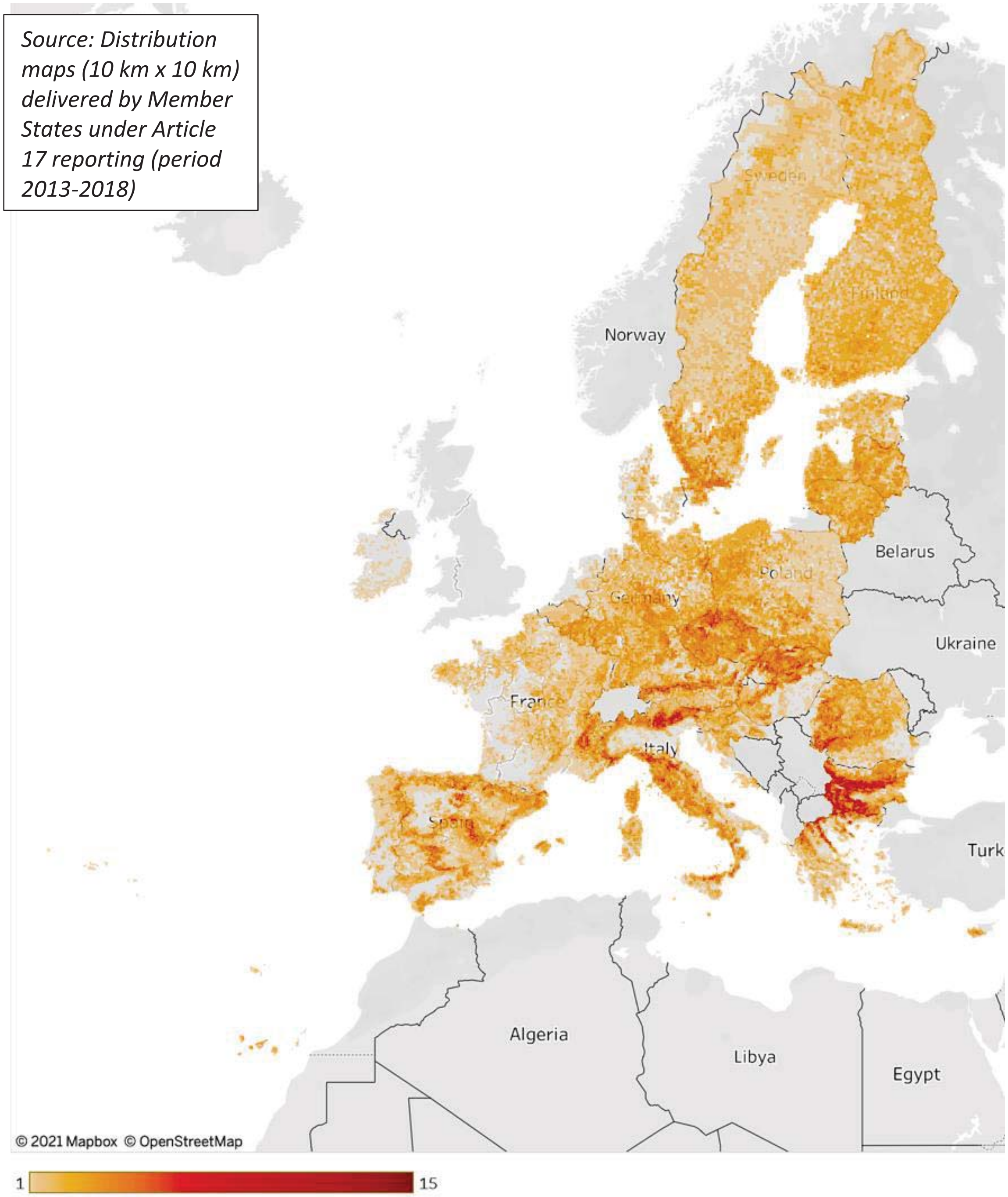
Table 3 gives the areas and proportion of Annex I forests for each Member State, including coverage by Natura 2000. Maps illustrating the distribution of different forest habitats in the EU are available in Annex A.

From the 357 952 km^2 of forest habitats (excluding Romania), **38 %** is estimated to be inside the Natura 2000 network (about **135 596 km^2**); this may be an underestimation since reports from Member States were not comprehensive on this regard. The coverage by Natura 2000 varies according to the sub-group, **from 52 %** for 'boreal forests' **to 31 %** for 'mountainous forests'. The proportion of habitats per sub-group of forest and their coverage is detailed in Table 4.

Coverage by Natura 2000 also greatly varies according to the Member State: **from near 85 %** (Estonia) **to about 9 %** (France) (Table 3).

However, several Member States reported over 75 % of Annex I forest habitats area inside Natura 2000 (Croatia, Estonia, Malta and Poland).

Map 1 – Distribution of the 69 Annex I forest habitats in the EU



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell.

Source: European Environment Agency – April 2021

Table 3 – Area and proportion of forest habitats per Member State

	Member State area (km^2)	In the Member State: Forest habitats area (km^2)	In the Member State: Forest habitats area (%)	Proportion of the forest habitats area (%)	Inside Natura 2000: Forest habitats area	Inside Natura 2000: % Forest habitats area
Austria	83 944	12 838.2	15.3	3.6	2 170.6	16.9
Belgium	30 683	1 409.1	4.6	0.4	757.6	53.8
Bulgaria	110 995	25 039.4	22.6	7.0	13 795.4	55.1
Croatia	55 590	13 278.9	23.9	3.7	10 025.1	75.5
Cyprus	9 249	1 501.3	16.2	0.4	545.2	36.3
Czechia	78 874	4 570.5	5.8	1.3	2 016.0	44.1
Denmark	44 162	643.5	1.5	0.2	117.2	18.2
Estonia	45 382	897.0	2.0	0.3	758.5	84.6
Finland	338 004	27 337.9	8.1	7.6	13 762.7	50.3
France	551 881	58 711.1	10.6	16.4	5 383.2	9.2
Germany	362 177	16 175.8	4.5	4.5	6 305.5	39.0
Greece	132 014	28 791.0	21.8	8.0	7 650.0	26.6
Hungary	93 012	4 003.0	4.3	1.1	2 679.0	66.9
Ireland	70 699	60.9	0.1	0.0	40.2	66.0
Italy	301 321	42 405.3	14.1	11.8	13 408.2	31.6
Latvia	64 590	968.6	1.5	0.3	309.2	31.9
Lithuania	65 289	1 204.1	1.8	0.3	399.0	33.1
Luxembourg	2 595	260.9	10.1	0.1	129.5	49.6
Malta	316	0.7	0.2	0.0	0.5	80.8
Netherlands	39 898	156.9	0.4	0.0	99.2	63.2
Poland	312 683	8 070.0	2.6	2.3	6 378.3	79.0
Portugal	92 378	715.5	0.8	0.2	515.0	72.0
Romania (*)	*238 404*	59 126.3	24.8		20 017.6	33.9
Slovakia	49 026	6 726.6	13.7	1.9	2 210.3	32.9
Slovenia	20 274	6 701.5	33.1	1.9	3 396.4	50.7
Spain	506 222	57 153.3	11.3	16.0	22 610.0	39.6
Sweden	450 110	38 331.4	8.5	10.7	20 134.2	52.5
Total	4 149 772	417 078.7	10.1		155 613.8	37.3
Total (without Romania)	**3 911 772**	**357 952.4**	**9.2**		**135 596.2**	**37.9**

Notes: Member States with more than 9.2 % (the EU average) of their terrestrial area covered by wetlands are highlighted; (*) areas reported by Romania are overestimated.

Source: European Environment Agency – April 2021

Table 4 – Area and proportion of forest habitats per sub-group

		Inside Natura 2000	
EU27 excluding Romania	Area (km^2)	Forest area (km^2)	% forest area
Boreal forests	**68 286**	**35 184**	**52**
9010	36 315	22 199	61
9020	440	196	45
9030	350	139	40
9040	19 600	11 622	59
9050	4 464	560	13
9060	7 116	468	7
Temperate forests	**172 384**	**59 752**	**35**
9110	21 009	6 113	29
9120	15 384	2 530	16
9130	56 043	13 692	24
9140	612	161	26
9150	5 845	2 613	45
9170	8 347	4 320	52
9180	2 472	1 095	44
9190	1 785	879	49
91A0	61	40	65
91AA	6 007	1 193	20
91B0	333	191	57
91BA	245	188	77
91CA	2 440	1 432	59
91G0	3 239	1 760	54
91H0	938	550	59
91I0	1 515	1 200	79
91J0	1	1	100
91K0	16 338	11 475	70
91L0	3 427	1 251	37
91M0	22 986	7 185	31
91P0	185	157	85
91Q0	20	13	63
91R0	85	48	57
91S0	268	222	83
91T0	277	99	36
91U0	9	4	49
91W0	2 124	1 143	54
91Z0	389	197	51
Mediterranean & Macaronesian forests	**66 335**	**24 911**	**38**
9210	3 271	1 916	59
9220	347	280	81
9230	13 154	3 170	24
9240	3 445	1 544	45
9250	457	452	99
9260	8 528	2 034	24
9270	570	570	100
9280	996	221	22

Source: European Environment Agency – April 2021

		Inside Natura 2000	
EU27 excluding Romania	**Area (km²)**	**Forest area (km²)**	**% forest area**
9290	438	175	40
9310	3	3	100
9320	1 966	1 228	62
9330	4 284	2 143	50
9340	27 784	10 545	38
9350	297	79	27
9360	603	398	66
9380	123	121	99
9390	61	31	50
93A0	6	2	34
Mountainous forests	**50 947**	**15 748**	**31**
9410	12 376	3 828	31
9420	4 007	981	24
9430	1 516	901	59
9510	83	75	91
9520	13	13	100
9530	7 896	1 918	24
9540	21 677	5 506	25
9550	737	626	85
9560	2 153	1 571	73
9570	1	1	83
9580	16	17	110
9590	3	3	90
95A0	470	309	**31**
TOTAL	**357 952**	**135 596**	**38**

Source: European Environment Agency – April 2021

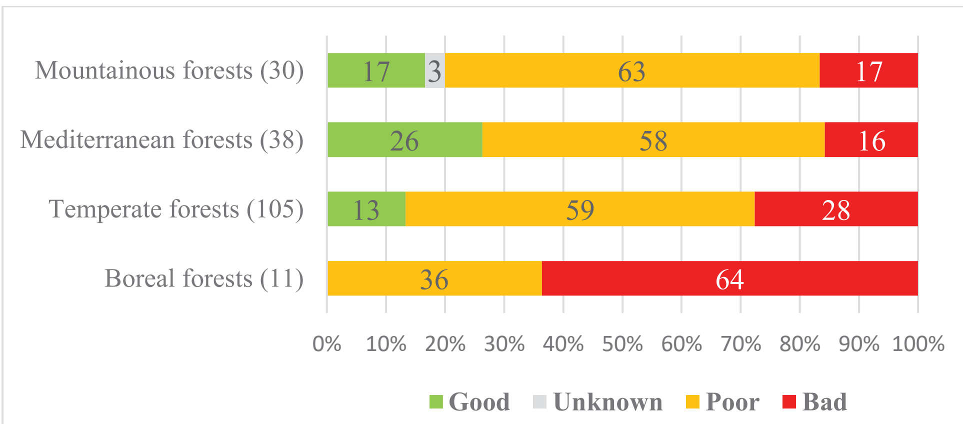
Conservation status and trends

The vast majority (**84 %**) of the assessments of the 69 forest habitats at the EU level have an **unfavourable** conservation status (58 % poor and 26 % bad). Only **16 %** have a **good** conservation status. There are some differences between the different habitat groups (Figure 1): 'Mediterranean forests' has the highest proportion of good status (26 %) and the 'Boreal forests' the worst status (100 % unfavourable).

Among the habitat assessments that do not have a good status, under one-fifth have a **deteriorating** trend (**17 %**) while **18 %** have an improving trend. Near half have a stable trend – not improving nor deteriorating – (**47 %)**; the conservation status trend is unknow for **17 %** of the assessments. The group with the worst conservation status trends is **'Boreal forests'** (**45 % deteriorating**); however, '**Mountainous forests**' have the higher proportion of **improving** trends (**28** %) (Figure 2).

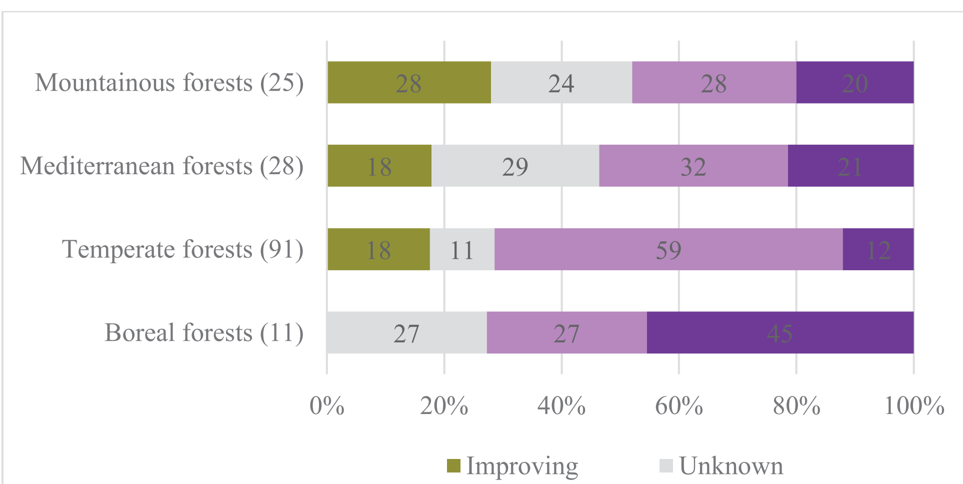
Details on conservation status and conservation status trends for each Member State are given in Table 5.

Figure 1 – Conservation status of forests at the EU level (in percentage)



Note: Number of assessments per group shown in brackets.

Figure 2 – Conservation status trends of forests at the EU level (in percentage)



Note: Number of assessments per group shown in brackets.

Table 5 – Conservation status and trends of forest habitats in the Member States (in percentage)

Member States	FV	U1-	U1+	U1=	U1x	U2-	U2+	U2=	U2x	XX
AT (25)	16	8	16	20	20			8	8	4
BE (11)			18	9	9		18	27	18	
BG (51)	31		55	8	4				2	
CY (8)	63			13				25		
CZ (18)		6		44		33		6	6	6
DE (26)	46	12	8	8		19		4		4
DK (10)						70			30	
EE (5)	20	60							20	
ES (44)	7	2	7	34	27	7		5	7	5
FI (11)	9	18		45		18			9	
FR (47)	23	4	4	32	9	6		6	9	6
GR (22)	73		18	5			5			
HR (23)	78			13		9				
HU (10)	10			50		10		30		
IE (2)						50		50		
IT (58)	10	19	2	33	9	16		7	2	3
LT (7)	14				29	29			29	
LU (4)	75			25						
LV (6)					33			17	50	
MT (4)	25			25				50		
NL (3)			33	33		33				
PL (19)	32	5		42		11		11		
PT (16)	6	19		25		50				
RO (35)	63			23				6	3	6
SE (18)	6	6		6	17	11		28	28	
SI (13)	31	15		54						
SK (23)	43			35	9	9			4	

Notes: FV = good, U1 = poor, U2 = bad, XX = unknown conservation status
'-' = deteriorating, '+' = improving, '=' = stable, 'x' = unknown conservation status trend; number of assessments per Member State shown in brackets.

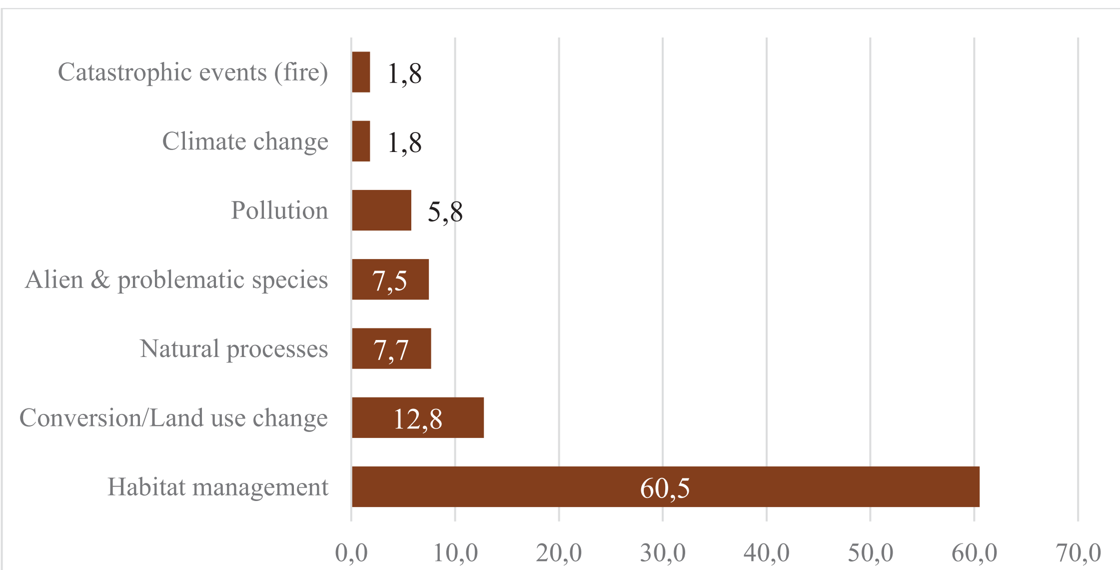
Pressures

Forest habitats are subject to a wide diversity of pressures resulting in their degradation and extirpation. According to Member States reports under Article 17 of the Habitats Directive, the top three groups of pressures (in percentage of the total) are (Figure 3):

- **Habitat management** with close to **61 %** of all pressures; these include inadequate forestry practices like removal of dead and old trees (30 %), clear-cutting (10 %), reduction of old growth forest (8 %)
- **Conversion and land use change** amounts to **13 %**; from these, 45 % correspond to conversion to other forest types (including monocultures), 22 % to construction of urban, commercial, industrial and leisure areas, and 12 % to transport infrastructure
- **Natural processes**, with about **8 %**; this is mainly due to interspecific relations (competition, parasitism and pathogens) (43 %) and changes in species composition (34 %)

Equally important is **alien and problematic species** with over **7 %**, mainly invasive alien species (58 %), and plant diseases, pathogens, and pests (26 %).

Figure 3 – Pressures reported for forest habitats (in percentage)



Note: based on pressures reported as 'high-ranking'.

Condition of habitats

Member States reported on the condition of habitat types under Article 17 of the Habitats Directive. This data can be used to estimate the area of forest habitats assessed as degraded (condition not-good) therefore, requiring restoration.

The area of Annex I forest habitats that would need to be restored, i.e., improved condition, is **at least 79 210 km^2**, representing **22 %** of the total area reported for this group of habitats (the values exclude Romania). However, the condition of habitats reported as 'unknown' (or not reported) is over 116 444 km^2 (33 % of the total area). This means that the area requiring restoration is bigger than 79 210 km^2; for example, assuming that half of the 'unknown' area is in a not-good condition, the area to be restored would be over 137 000 km^2 or 195 000 km^2 if all the 'unknown' is assumed to be in a 'not-good' condition (22 % of the total area). Table 6 gives information for each of the 69 forest habitats (excluding Romania) and Table 7 the condition areas and percentage for each of the Member States.

In addition to the habitat condition, Member States also reported on the 'favourable reference areas'[6]. Comparing these areas with the actual habitat areas allows to estimate how much area of the habitat would need to be re-created to achieve a good distribution and area of the habitat. Based on this data, it is estimated that a **strict minimum** of **3 500 km^2** would need to be **re-created** to achieve a 'favourable area'.

- 830 km^2 of Boreal forest habitats
- 1 050 km^2 of Temperate forest habitats
- 1 270 km^2 of Mediterranean forest habitats
- 350 km^2 of Mountainous forest habitats

However, these values are much higher since several Member States did not provide enough information in their reports to allow a more realistic estimation.

[6] The surface area in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the habitat type; this should include necessary areas for restoration or development for those habitat types for which the present coverage is not sufficient to ensure long-term viability

Table 6 – Condition of forest habitats per Annex I habitat type

		Condition (area in km2)			Condition (in percentage)		
	Habitat area	Good	Not-good	Unknown	Good	Not-good	Unknown
Total	**357 952**	**162 296**	**79 211**	**116 444**	**45**	**22**	**33**
Boreal forests	**68 286**	**16 160**	**6 728**	**45 398**	**24**	**10**	**66**
9010	36 315	13 774	3 568	18 973	38	10	52
9020	440	118	120	202	27	27	46
9030	350	121	147	82	35	42	23
9040	19 600	1 452	2 590	15 558	7	13	79
9050	4 464	646	249	3 569	14	6	80
9060	7 116	49	54	7 013	1	1	99
Temperate forests	**172 384**	**92 798**	**51 610**	**27 976**	**54**	**30**	**16**
9110	21 009	12 567	4 585	3 857	60	22	18
9120	15 384	2 294	11 883	1 207	15	77	8
9130	56 043	22 018	26 574	7 451	39	47	13
9140	612	148	51	414	24	8	68
9150	5 845	2 108	2 007	1 730	36	34	30
9170	8 347	5 662	2 044	641	68	24	8
9180	2 472	1 346	206	919	54	8	37
9190	1 785	727	1 042	16	41	58	1
91A0	61	43	18		70	30	
91AA	6 007	1 359	98	4 550	23	2	76
91B0	333	39	49	245	12	15	74
91BA	245	246			100		
91CA	2 440	2 421		18	99		1
91G0	3 239	2 541	482	215	78	15	7
91H0	938	640	81	217	68	9	23
91I0	1 515	1 385	85	46	91	6	3
91J0	1		1		35	65	
91K0	16 338	13 553	1 282	1 503	83	8	9
91L0	3 427	2 577	285	565	75	8	16
91M0	22 986	18 035	664	4 288	78	3	19
91P0	185	123	62		66	34	
91Q0	20	5	1	14	25	6	69
91R0	85	82	4		96	4	
91S0	268	268			100		
91T0	277	93	104	80	34	37	29
91U0	9	5	3	1	50	37	13
91W0	2 124	2 124			100		
91Z0	389	389			100		

Source: European Environment Agency – April 2021

		Condition (area in km2)			Condition (in percentage)		
	Habitat area	Good	Not-good	Unknown	Good	Not-good	Unknown
Mediterranean & Macaronesian forests	**66 335**	**28 921**	**14 727**	**22 687**	**44**	**22**	**34**
9210	3 271	1 858	40	1 373	57	1	42
9220	347	275	4	68	79	1	20
9230 (*)	13 154	8 945	7 378	-3 170	68	56	-24
9240	3 445	388	508	2 549	11	15	74
9250 (#)	457	572	1	-115	125		-25
9260	8 528	1 956	511	6 060	23	6	71
9270	570	514		56	90		10
9280	996	896		100	90		10
9290	438	394	1	43	90		10
9310	3		1	3		20	80
9320	1 966	1 280	230	456	65	12	23
9330	4 284	1 540	1 470	1 273	36	34	30
9340	27 784	9 600	4 395	13 789	35	16	50
9350	297	267		30	90		10
9360	603	312	156	135	52	26	22
9380	123	65	23	35	53	18	28
9390	61	55	6		90	10	
93A0	6	3	3		46	54	
Mountainous coniferous forests	**50 947**	**24 418**	**6 146**	**20 383**	**48**	**12**	**40**
9410	12 376	8 383	324	3 670	68	3	30
9420	4 007	1 118	102	2 786	28	3	70
9430	1 516	228	1 087	201	15	72	13
9510	83	74	2	8	89	2	9
9520	13	8	3	2	59	24	16
9530	7 896	3 315	739	3 842	42	9	49
9540	21 677	9 806	3 524	8 346	45	16	39
9550	737	626		111	85		15
9560	2 153	661	278	1 214	31	13	56
9570	1	1			68	19	13
9580	16	11	1	4	71	4	25
9590	3	3			100		
95A0	470	185	86	199	39	18	42

Notes: Areas reported by Romania excluded from the table; (*) issue with data for habitat 9230 in the Atlantic region of France (areas repeated in 'good' and +not-good' condition); (#) (*) issue with data for habitat 9250 in the Mediterranean region of Italy (area in 'good' condition bigger than total area of the habitat).

Table 7 – Condition of Annex I forest habitats per Member State

	Habitats' area (km²)				Percentage		
Member State	**Total**	**Good**	**Not-good**	**Unknown**	**Good**	**Not-good**	**Unknown**
AT	12 838	11 612	590	636	90	5	5
BE	1 409	53	192	1 164	4	14	83
BG	25 039	25 038	1		100		
CY	1 501	1 285	216		86	14	
CZ	4 570	3 235	461	874	71	10	19
DE	16 176	14 517	1 129	530	90	7	3
DK	644	2	642			100	
EE	897	586	290	21	65	32	2
ES	57 153	13 314	13 608	30 231	23	24	53
FI	27 338	11 804	4 901	10 633	43	18	39
FR (#)	58 711	15 968	46 922	-4 178	27	80	-7
GR	28 791	25 122	204	3 465	87	1	12
HR	13 279	13 265	14		100		
HU	4 003	1 894	1 520	590	47	38	15
IE	61	42	19		69	31	
IT	42 405	10 783	845	30 778	25	2	73
LT	1 204			1 204			100
LU	261	241	1	19	92		7
LV	969	613	355		63	37	
MT	1				70	30	
NL	157	76	81		49	51	
PL	8 070	3 936	4 133	1	49	51	
PT	716	297	261	158	41	36	22
RO (*)	59 126	55 410	3 401	315	94	6	1
SE	38 331	3 321	1 250	33 760	9	3	88
SI	6 702	5 181	1 508	13	77	22	
SK	6 726	113	69	6 544	2	1	97

Notes: (*) areas reported by Romania largely overestimated; (#) issue with data for several habitats (repeated areas for 'good' and 'not-good condition' – 9230, 9330)

Source: European Environment Agency – April 2021

Carbon stock and sequestration

Forests are the dominant ecosystem in terms of area, sequestration and carbon storage potential. Annual sequestration of forest habitats reaches 100 Mio tons C per year equivalent to 367 Mio tons of CO_2. The storage capacity is estimated to range between 2,8 and 8,8 Gt of carbon equivalent to 10,3 Gt and 32,3 Gt of CO_2. Despite area covered by forest is more than twice as much as wetland area and sequestration rate is five times higher, the storage capacity for forests per km^2 is slightly lower compared to wetlands. Forests acumulate carbon over decades to centuries before reaching saturation point. If harvested, the climate change mitigation effect is determined by the use of wood and timber (e.g. short-term storage if used for fuel or papel versus long-term storage in furniture and construction). Harvesting also leads to loss of soil organic carbon by erosion and mineralization.

Table 8 – Carbon stock and sequestration of Annex I forest habitats

EU27 excluding Romania	Forest area (km^2)	Total Carbon Stock (Mt)		Potential carbon sequestration rate (Mt y^{-1})
	EU-27	min	max	mean
Boreal forests	**68 285.55**	**512.14**	**1536.42**	**20.52**
9010	36 315.02	272.36	817.09	10.89
9020	440.22	3.30	9.90	0.17
9030	350.00	2.63	7.88	0.11
9040	19 600.00	147.00	441.00	5.88
9050	4 464.06	33.48	100.44	1.34
9060	7 116.26	53.37	160.12	2.13
Temperate forests	**172 384.14**	**1293.96**	**4756.65**	**56.88**
9110	21 009.04	157.57	630.27	7.88
9120	15 383.62	115.38	461.51	5.77
9130	56 042.97	420.32	1681.29	21.02
9140	612.33	4.59	18.37	0.23
9150	5 844.65	43.83	175.34	2.19
9170	8 347.21	62.60	187.81	3.13
9180	2 471.91	18.54	55.62	0.93
9190	1 785.03	13.39	53.55	0.54
91A0	61.08	0.46	1.83	0.02
91AA	6 006.88	45.05	135.15	0.90
91B0	333.10	2.50	7.49	0.05
91BA	245.29	3.68	7.36	0.11
91CA	2 439.55	18.30	36.59	0.55
91G0	3 238.73	24.29	72.87	1.21
91H0	938.37	7.04	21.11	0.14
91I0	1 515.00	11.36	34.09	0.23
91J0	0.83	0.00	0.01	0.00
91K0	16 338.05	122.54	490.14	6.13
91L0	3 427.09	25.70	77.11	1.29
91M0	22 985.73	172.39	517.18	3.45
91P0	185.00	2.78	5.55	0.08
91Q0	20.18	0.15	0.30	0.00
91R0	85.49	0.64	1.28	0.02
91S0	268.02	2.01	8.04	0.10
91T0	276.78	0.00	4.15	0.06
91U0	9.16	0.00	0.14	0.00
91W0	2 123.92	15.93	63.72	0.80

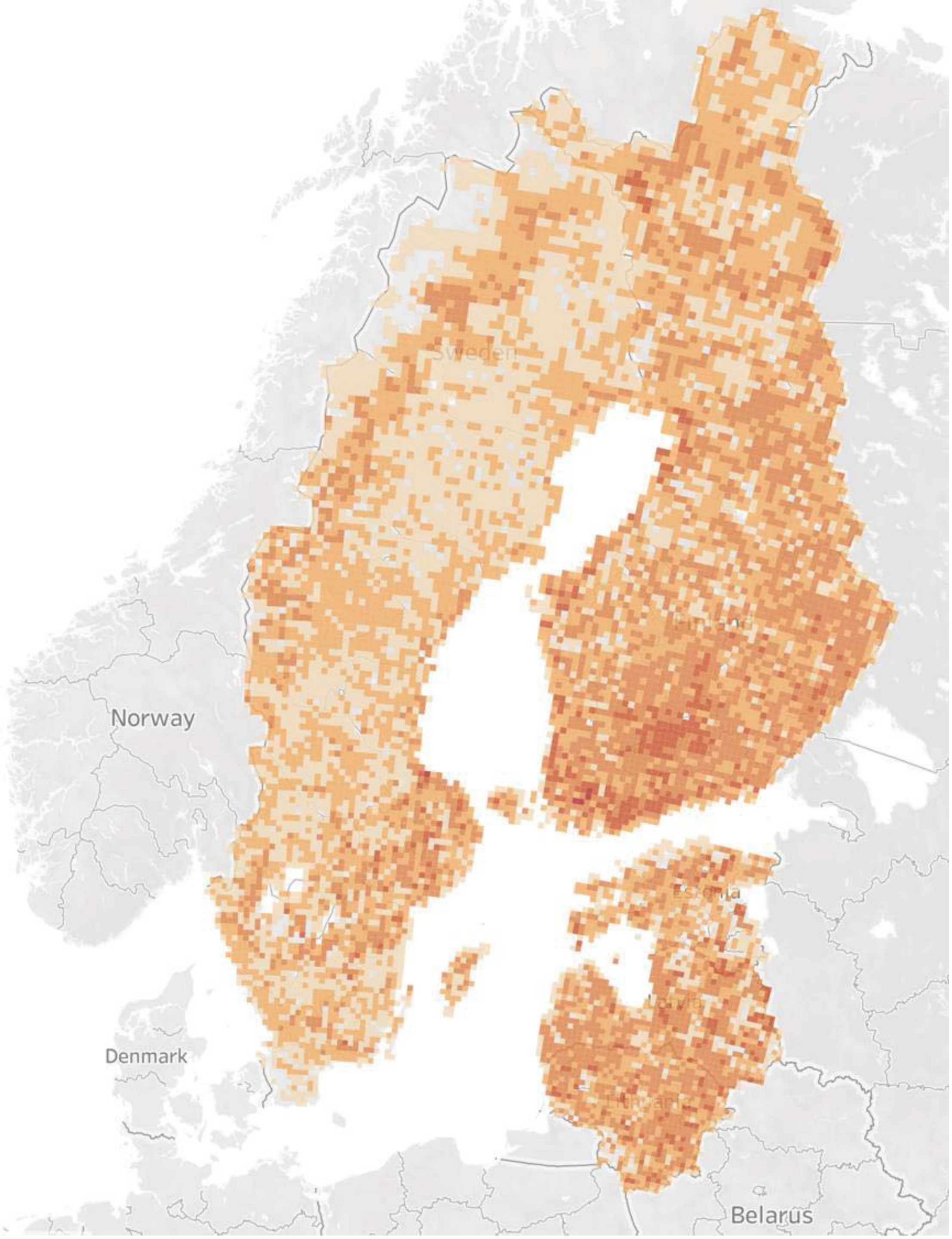
Source: European Environment Agency – April 2021

EU27 excluding Romania	Forest area (km^2)	Total Carbon Stock (Mt)		Potential carbon sequestration rate (Mt y^{-1})
	EU-27	min	max	mean
91Z0	389.14	2.92	8.76	0.06
Mediterranean forests	**66 334.91**	**735.25**	**1572.82**	**13.99**
9210	3271.37	24.54	98.14	1.23
9220	346.69	2.60	10.40	0.13
9230	13153.76	98.65	295.96	1.97
9240	3444.99	25.84	77.51	0.52
9250	457.31	3.43	10.29	0.07
9260	8527.79	63.96	255.83	1.92
9270	570.15	4.28	17.10	0.21
9280	996.00	7.47	29.88	0.37
9290	438.06	0.00	6.57	0.03
9310	3.47	0.03	0.08	0.00
9320	1966.46	14.75	29.50	0.15
9330	4283.86	64.26	96.39	0.96
9340	27784.22	416.76	625.15	6.25
9350	297.12	2.23	6.69	0.09
9360	602.94	4.52	9.04	0.05
9380	122.89	0.92	2.77	0.03
9390	61.40	0.92	1.38	0.01
93A0	6.44	0.10	0.14	0.00
Mountainous forests	**50 947.05**	**255.36**	**950.57**	**9.56**
9410	12 376.21	185.64	371.29	4.64
9420	4 006.57	0.00	60.10	0.90
9430	1 515.95	0.00	22.74	0.34
9510	82.78	1.24	1.86	0.02
9520	13.25	0.20	0.30	0.00
9530	7 896.00	59.22	118.44	1.78
9540	21 676.59	0.00	325.15	1.63
9550	736.98	5.53	11.05	0.06
9560	2 152.77	0.00	32.29	0.16
9570	0.95	0.00	0.01	0.00
9580	15.80	0.00	0.24	0.00
9590	2.91	0.00	0.04	0.00
95A0	470.29	3.53	7.05	0.04
TOTAL	**357 951.65**	**2796.70**	**8816.44**	**100.97**

Note: areas reported by Romania note included

Annex A

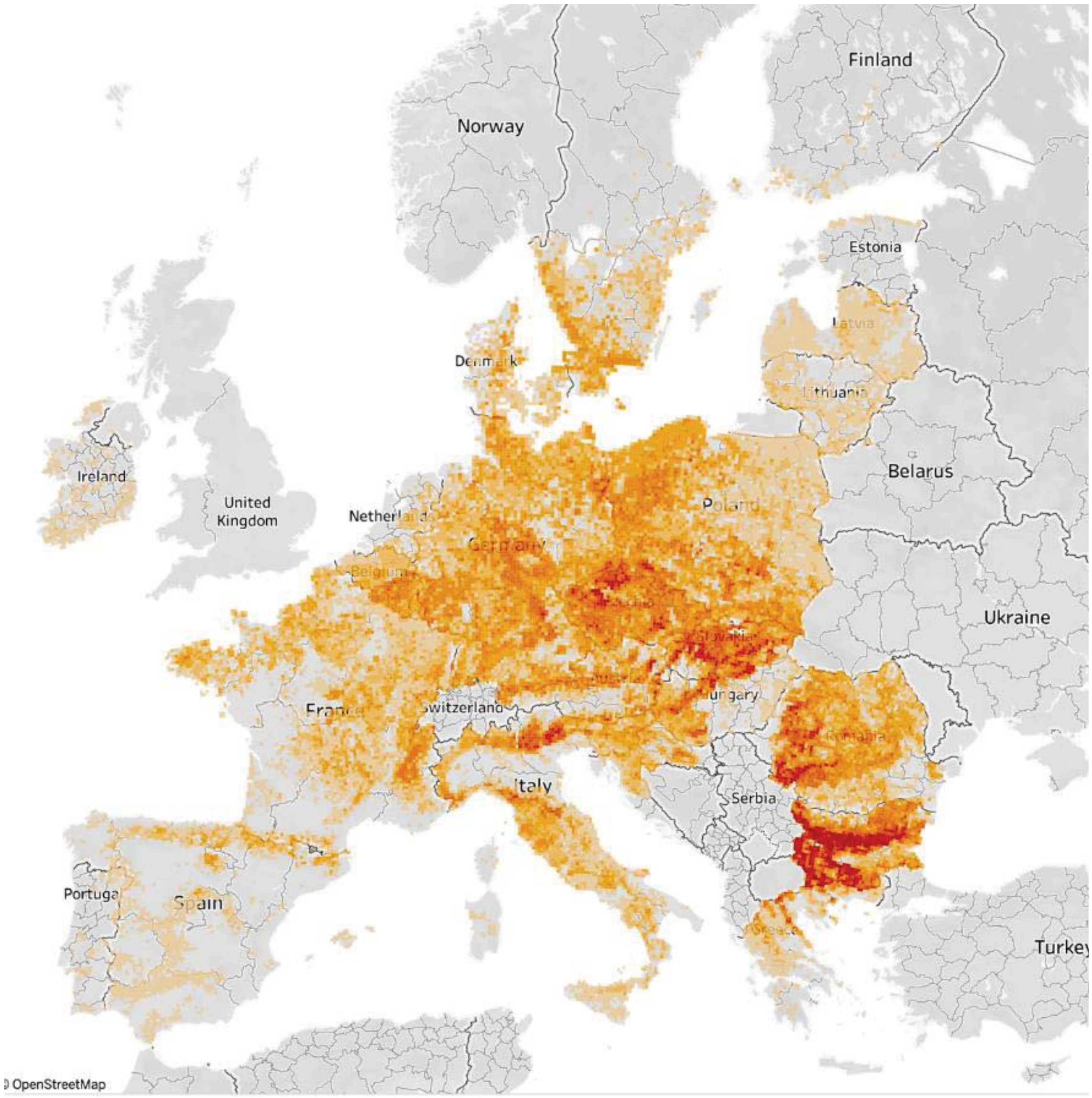
Map 2 – Distribution of Annex I Boreal forest habitats (9010, 9020, 9030, 9040, 9050, 9060)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell.

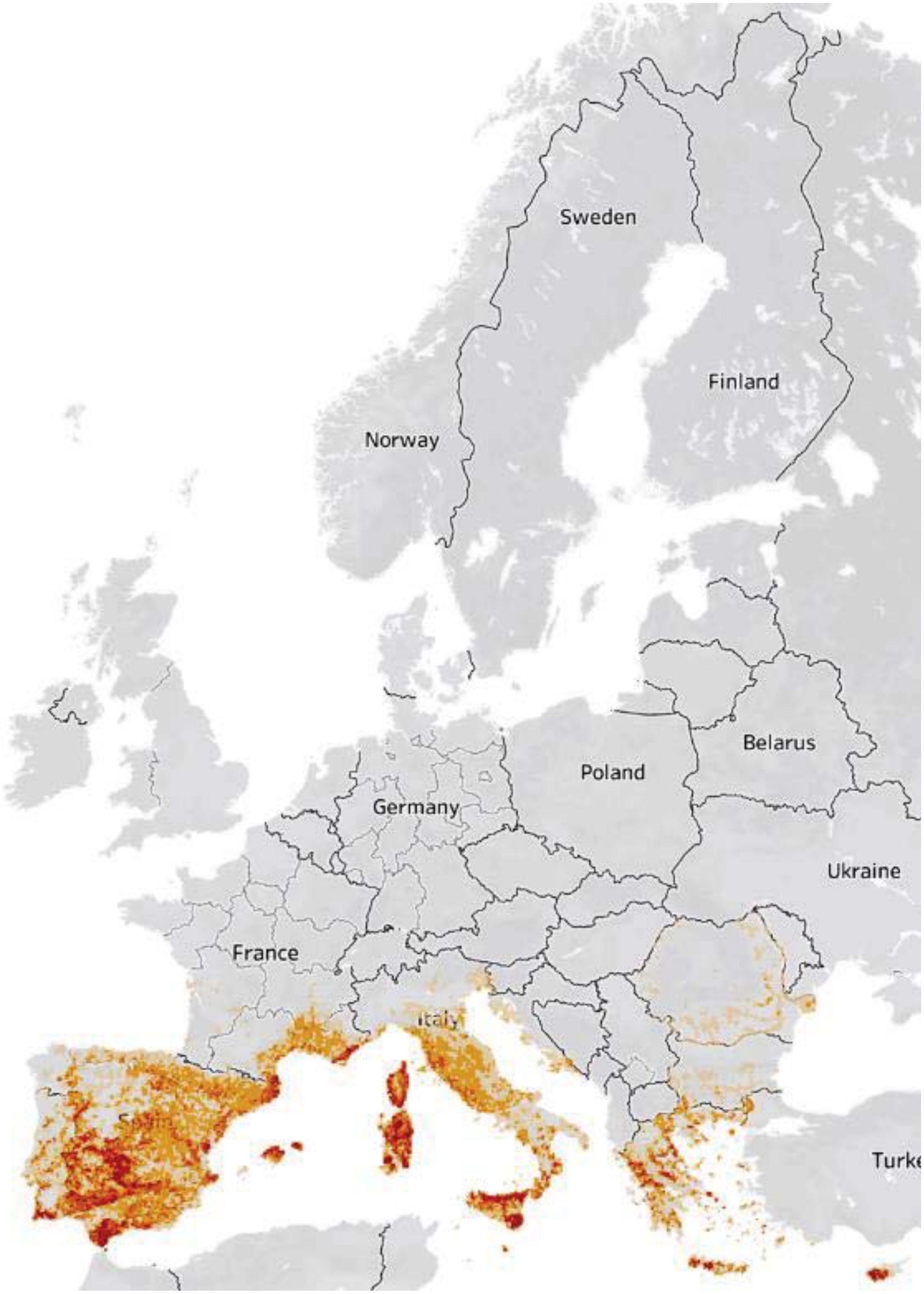
Source: European Environment Agency – April 2021

Map 3 – Distribution of Annex I Temperate forest habitats (9110-9150, 9170-91C0, 91G0-91M0, 91P0-91CA)



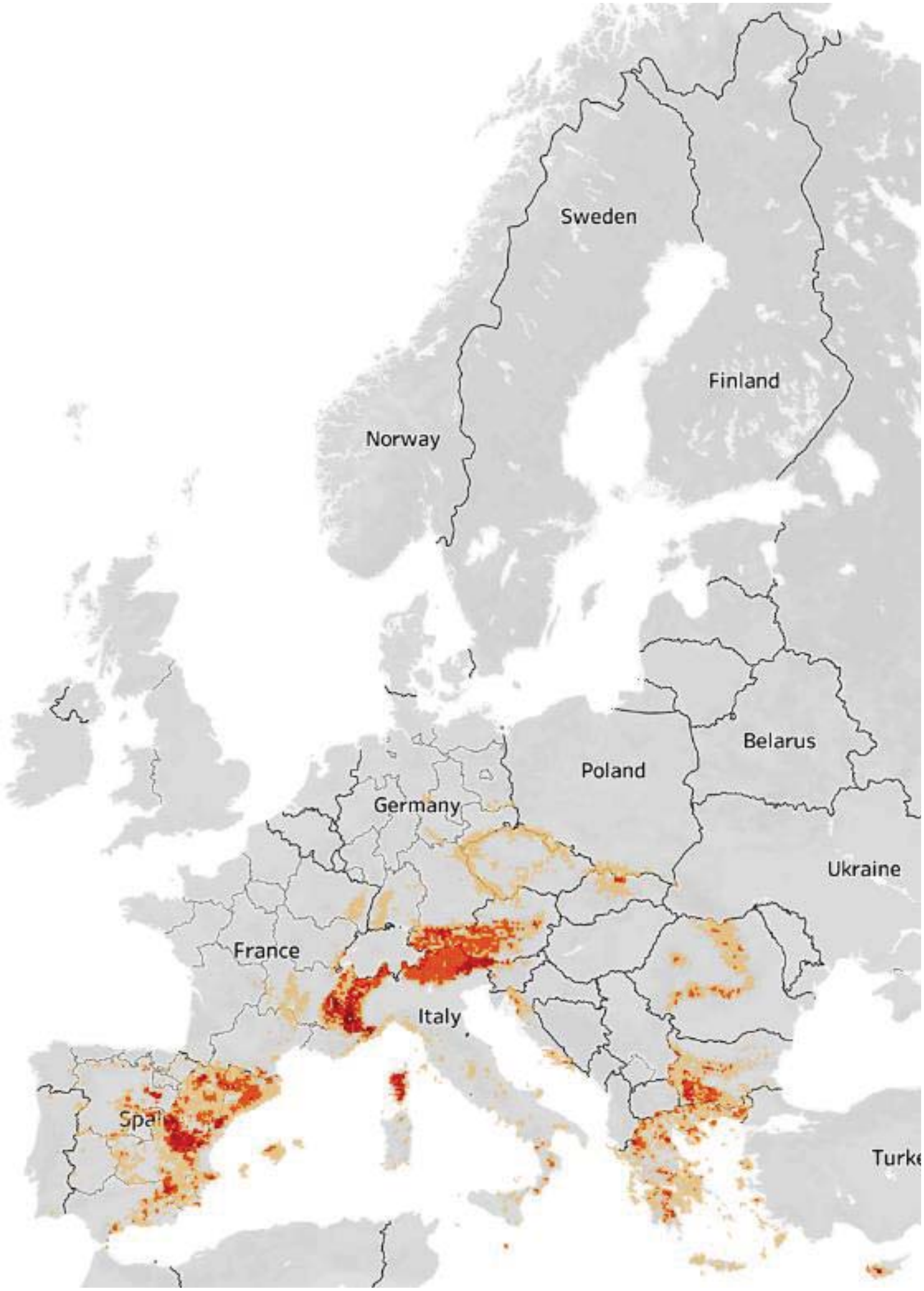
Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell. Macaronesian islands not shown in the map.

Map 4 – Distribution of Annex I Mediterranean forest habitats (9210-9290, 9310-9360, 9380-93A0)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell. Macaronesian islands not shown in the map.

Map 5 – Distribution of Annex I Mountainous forest habitats (9410-9430, 9510-95A0)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell. Macaronesian islands not shown in the map.

Source: European Environment Agency – April 2021

EUROPEAN
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SWD(2022) 167 final

PART 8/12

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

ANNEX VIII-c

Accompanying the

proposal for a Regulation of the European Parliament and of the Council

on nature restoration

{COM(2022) 304 final} - {SEC(2022) 256 final} - {SWD(2022) 168 final}

EN EN

Table of Contents

Annex VIII-c: AGRICULTURAL HABITATS AND GRASSLANDS

Introduction

This paper provides information derived from the Member States' reports and assessments under Article 17 of the Habitats Directive. It is a background information to help identify possible restoration targets for the 'legal binding instrument' under the EU Biodiversity Strategy to 2030.

The 'agricultural habitats and grasslands' group include, 35 Annex I habitat types (see Table 1): all grasslands (except alluvial meadows), and a selection of habitats dependent on agricultural management (particularly grazing) from different types.

Table 1 – Agricultural and grassland Annex I habitat types selected

Costal and dune habitats (2 types)		**Grasslands**	
1630	Boreal Baltic coastal meadows	6220	Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea
21A0	Machairs	6230	Species-rich Nardus grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe)
Heath and scrub habitats (5 types)		6240	Sub-Pannonic steppic grasslands
4030	European dry heaths	6250	Pannonic loess steppic grasslands
4040	Dry Atlantic coastal heaths with	6260	Pannonic sand steppes
4090	Endemic oro-Mediterranean heaths	6270	Fennoscandian lowland species-rich dry to
5130	Juniperus communis formations on heaths or calcareous grasslands	6280	Nordic alvar and precambrian calcareous flatrocks
8240	Limestone pavements	62A0	Eastern sub-Mediterranean dry grasslands (Scorzoneratalia villosae)
Grasslands (25 types)		62B0	Serpentinophilous grassland of Cyprus
6110	Rupicolous calcareous or basophilic grasslands of the Alysso-Sedion albi	62C0	Ponto-Sarmatic steppes
6120	Xeric sand calcareous grasslands	62D0	Oro-Moesian acidophilous grasslands
6130	Calaminarian grasslands of the Violetalia calaminariae	6410	Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)
6140	Siliceous Pyrenean Festuca eskia grasslands	6420	Mediterranean tall humid grasslands of the Molinio-Holoschoenion
6150	Siliceous alpine and boreal grasslands	6510	Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)
6160	Oro-Iberian Festuca indigesta	6520	Mountain hay meadows
6170	Alpine and subalpine calcareous grasslands	**Dehesas and wooded meadows (3 types)**	
6180	Macaronesian mesophile grasslands	6310	Dehesas with evergreen Quercus spp.

6190	Rupicolous pannonic grasslands (Stipo-Festucetalia pallentis)	6530	Fennoscandian wooded meadows
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia)	9070	Fennoscandian wooded pastures

'Agri-habitats and grasslands' coverage in the EU

The 35 habitat types selected cover close to **177 442 km²** (**4.5 %** of the EU terrestrial area[1]); this excludes areas reported by Romania, which are known to be largely overestimated[2].

The data available from Corine Land Cover[3] and from the Ecosystems Map of Europe[4] do not allow a straightforward comparison between the total area of agricultural habitats and grasslands in the EU and the area covered by these Annex I habitats. This is mainly due to the nomenclatures used and the spatial resolution of the datasets. A comparison between these data sources is given in Table 2 below.

Table 2 – Agricultural habitats and grassland areas (km²) from different sources (EU27)

Corine Land Cover 2018 (level 3)

Pastures and grasslands	**417 957**
231 – Pastures	326 224
321 – Natural grasslands	91 733
Heterogenous agricultural areas	**377 584**
241 – Annual crops associated with permanent crops	5 517
242 – Complex cultivation patterns	174 253
243 – Agricultural mosaics with significant natural vegetation	164 751

[1] Area of habitats calculated from the area reported by Member States as 'best estimate' or 'average of minimum/maximum'
[2] The average total area of agri-habitats and grasslands habitats reported by Romania is 54 124 km²
[3] https://www.eea.europa.eu/data-and-maps/dashboards/land-cover-and-change-statistics
[4] https://www.eea.europa.eu/themes/biodiversity/mapping-europes-ecosystems

244 – Agro-forestry areas	33 062

Ecosystems map (level 3)

E – Grasslands and land dominated by forbs, mosses or lichens	**624 605**
E1 – Dry grasslands	88 042
E2 – Mesic grasslands	443 643
E3 – Seasonally wet and wet grasslands	48 060
E4 – Alpine and sub-alpine grasslands	24 875
E6 – Inland salt steppes	4 893
E7 – Sparsely wooded grasslands	15 092

The areas of agricultural habitats and grasslands have a good representation in most EU countries (see Map 1), but better in southern and mountainous regions. The Member States with the highest proportion of those habitats are Spain (16 %), Croatia (12 %), Greece (9 %), Austria (7 %), Italy (6 %) and Luxembourg (6 %); ten Member States have less than 2 % of their territory covered by Annex I agricultural habitats and grasslands.

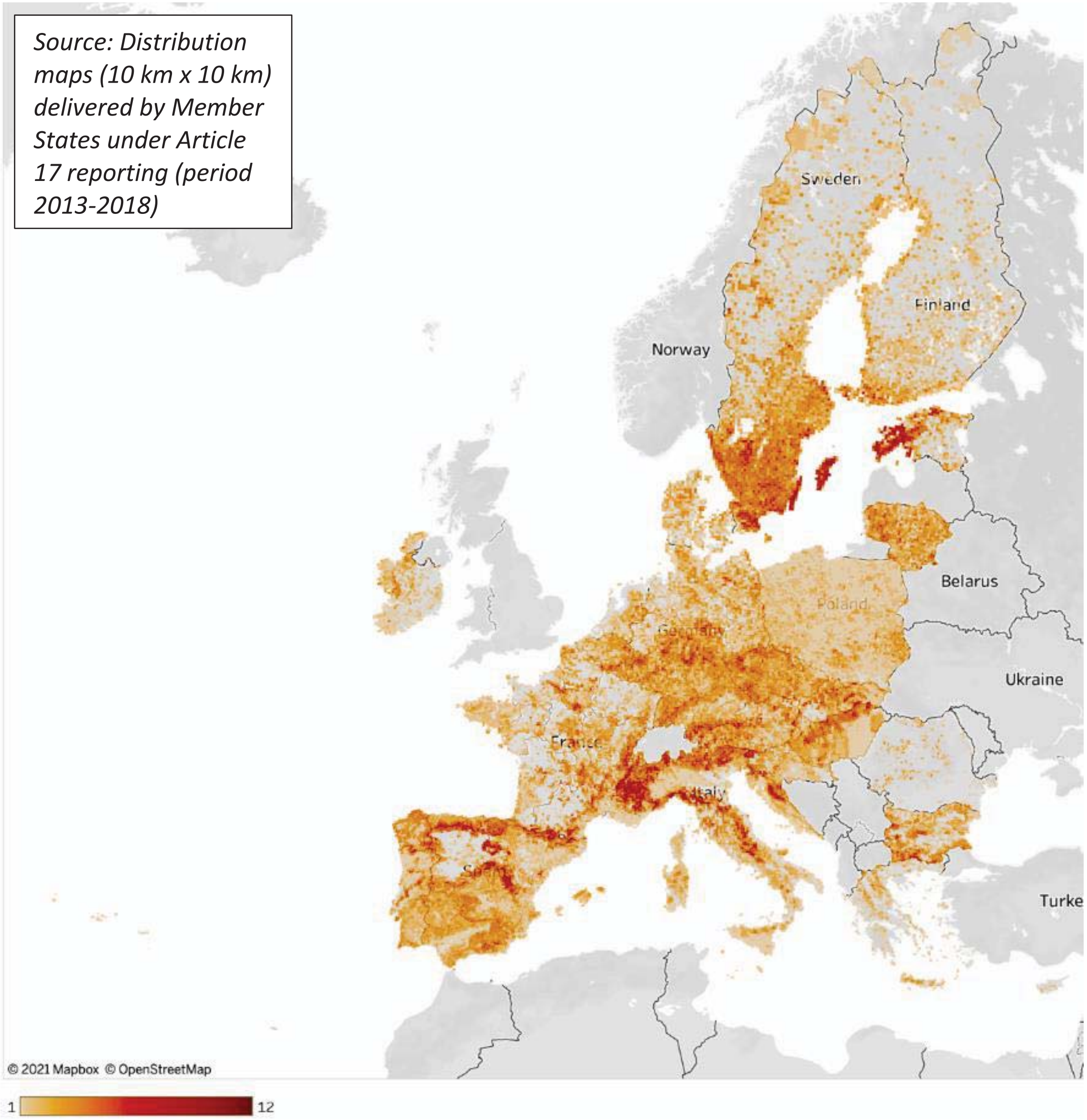
Table 3 gives the areas and proportion of agri-habitats and grasslands for each Member State, including coverage by Natura 2000. Maps illustrating the distribution of different wetland habitats in the EU are available in Annex A.

From the **177 442 km^2** of agricultural habitats and grasslands (excluding Romania), over **43 %** is estimated to be inside the Natura 2000 network (about **77 025 km^2**); this may be an underestimation since reports from Member States were not comprehensive on this regard. The coverage by Natura 2000 varies according to the sub-group, **from 67 %** for 'coastal and dune habitats' **to 35 %** for 'dehesas and wooded meadows'. The proportion of habitats per sub-group of 'agricultural habitats and grasslands' and their coverage is detailed in Table 4.

Coverage by Natura 2000 also greatly varies according to the Member State: **from over 90 %** (Bulgaria) **to less than 25 %** (Austria, France, Lithuania, Poland and Slovakia) (Table 3).

However, several Member States reported **over 75 %** of these habitats' area inside Natura 2000 (Estonia, Finland, Malta, Netherlands, Portugal and Slovenia).

Map 1 – Distribution of the 35 Annex I agricultural habitats and grasslands in the EU



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell.

Table 3 – Area and proportion of agricultural habitats and grasslands per Member State

	Member State area (km²)	In the Member State		Proportion of the Agri-habitats & grassland area (%)	Inside Natura 2000	
		Agri-habitats & grassland area (km²)	Agri-habitats & grassland area (%)		Agri-habitats & grassland area	% Agri-habitats & grassland area
Austria	83 944	6240.0	7.4	3.4	1329.5	21.3
Belgium	30 683	218.2	0.7	0.1	106.0	48.6
Bulgaria	110 995	3344.0	3.0	1.8	3018.4	90.3
Croatia	55 590	6793.9	12.2	3.7	3277.4	48.2
Cyprus	9 249	15.0	1.1	0.1	4.6	54.6
Czechia	78 874	1876.3	2.4	1.0	481.3	25.7
Denmark	44 162	507.0	1.1	0.3	193.1	38.1
Estonia	45 382	460.1	1.0	0.2	373.9	81.3
Finland	338 004	400.4	0.1	0.2	328.6	82.1
France	551 881	24400.8	4.4	13.2	5090.7	20.9
Germany	362 177	3110.6	0.9	1.7	1931.4	62.1
Greece	132 014	4615.2	9.3	6.6	2139.0	34.6
Hungary	93 012	1274.8	1.4	0.7	938.2	73.6
Ireland	70 699	1626.4	2.3	0.9	945.9	58.2
Italy	301 321	17222.0	5.7	9.3	7562.9	44.0
Latvia	64 590	346.7	0.5	0.2	173.6	50.1
Lithuania	65 289	606.3	0.9	0.3	118.7	19.6
Luxembourg	2 595	149.5	5.8	0.1	63.0	42.2
Malta	316	9.6	3.0	0.0	7.4	77.1
Netherlands	39 898	254.8	0.6	0.1	191.3	75.1
Poland	312 683	8170.5	2.6	4.4	1803.5	22.1
Portugal	92 378	3987.0	4.3	2.2	3949.5	99.1
Romania (*)	*238 404*	54123.4	22.7		6166.8	11.4
Slovakia	49 026	2217.8	4.5	1.2	429.8	19.4
Slovenia	20 274	1452.9	7.2	0.8	1106.2	76.1
Spain	506 222	79158.1	15.6	42.7	37939.7	47.9
Sweden	450 110	8983.9	2.0	4.9	3521.0	39.2
Total	4 149 772	231 565.2	5.6		83 191.5	35.9
Total (without Romania)	**3 911 772**	**177 441.8**	**4.5**		**77 024.7**	**43.4**

Notes: Member States with more than 4.5 % (the EU average) of their terrestrial area covered by 'agricultural habitats and grasslands' are highlighted; (*) areas reported by Romania are overestimated.

Source: European Environment Agency – April 2021

Table 4 – Area and proportion of agricultural habitats and grasslands per sub-group

		Inside Natura 2000	
EU27 excluding Romania	**Area (km^2)**	**Agri/grassland area (km^2)**	**% Agri/grassland area**
Coastal and dune habitats	**365**	**243**	**67**
1630	334	216	65
21A0	31	27	86
Heath and scrub habitats	**29 493**	**16 498**	**56**
4030	15 156	8 514	56
4040	17	13	77
4090	12 033	6 575	55
5130	941	580	62
5430	270	258	96
8240	1 076	558	52
Grasslands	**115 616**	**49 041**	**42**
6110	987	479	49
6120	124	88	71
6130	17	11	65
6140	1 106	598	54
6150	10 776	3 637	34
6160	413	373	90
6170	9 009	5 580	62
6180	180	144	80
6190	41	36	89
6210	11 255	6 490	58
6220	30 441	17 189	56
6230	3 728	2 303	62
6240	394	335	85
6250	346	298	86
6260	413	270	66
6270	1 947	163	8

Source: European Environment Agency – April 2021

		Inside Natura 2000	
EU27 excluding Romania	**Area (km^2)**	**Agri/grassland area (km^2)**	**% Agri/grassland area**
6280	436	262	60
62A0	6 295	3 208	51
62B0 (*)	0	0	100
62C0	77	59	77
62D0	345	208	60
6410	2 806	874	31
6420	556	198	36
6510	21 978	5 318	24
6520	11 945	919	8
Dehesas and wooded meadows	**31 968**	**11 243**	**35**
6310	31 079	10 932	35
6530	70	35	49
9070	818	276	34
TOTAL	**177 442**	**77 025**	**43**

Note: (*) restricted to Cyprus (0.42 km^2)

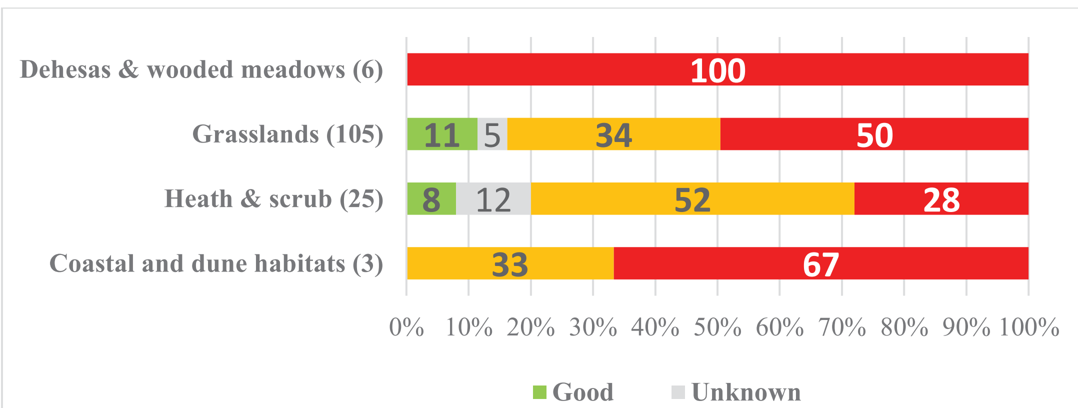
Conservation status and trends

The vast majority (**84 %**) of the assessments of the 35 agricultural habitats and grasslands at the EU level have an **unfavourable** conservation status (36 % poor and 48 % bad). Only **10 %** have a **good** conservation status. There are some differences between the different habitat groups (Figure 1): 'grasslands' has the highest proportion of good status (11 %) and the 'dehesas and wooded meadows' the worst status (100 % unfavourable, but only three habitats in this group).

Among the habitat assessments that do not have a good status, almost half have a **deteriorating** trend (**45 %**) while only **8 %** have an improving trend. An additional **25 %** maintain their unfavourable status; the conservation status trend is unknow for **22 %** of the assessments. The group with the worst conservation status trends is **'grasslands'** (**52 % deteriorating**); however, '**costal and dune**' habitats have the higher proportion of **improving** trends (**33** %) (Figure 2).

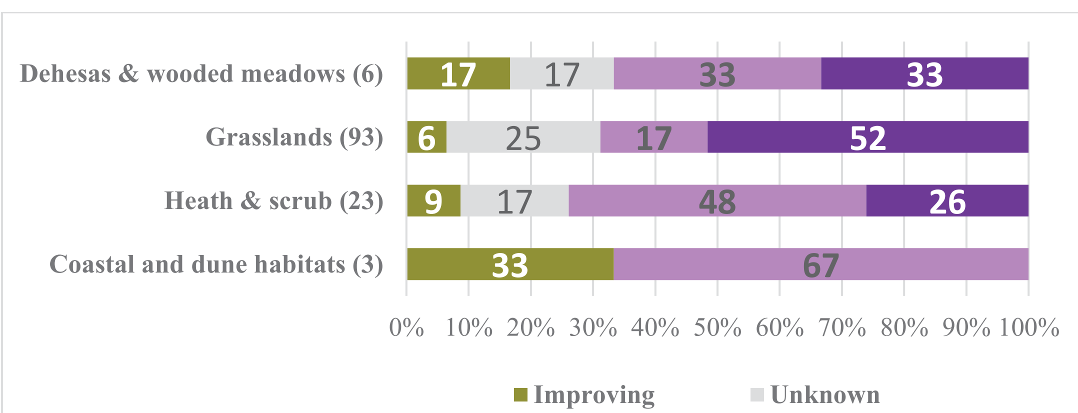
Details on conservation status and conservation status trends for each Member State are given in Table 5.

Figure 1 – Conservation status of agricultural habitats and grasslands at the EU level per sub-group (in percentage)



Note: Number of assessments per group shown in brackets.

Figure 2 – Conservation status trends of agricultural habitats and grasslands at the EU level per sub-group (in percentage)



Note: Number of assessments per group shown in brackets.

Table 5 – Conservation status and trends of agricultural habitats and grasslands in the Member States (in percentage)

Member States	FV	U1-	U1+	U1=	U1x	U2-	U2+	U2=	U2x	XX
AT (27)	7	4			30	19		4	33	4
BE (18)					6	28	28	6	33	
BG (41)	10			17	66				5	2
CY (3)	33			33				33		
CZ (21)	14	14		33	14	14		10		
DE (29)	14	28		10		48				
DK (11)		9				45		27	18	
EE (11)	36		18	36					9	
ES (40)	13	10	5	25	23	5			8	13
FI (12)	17		8			8		67		
FR (53)	28	6	2	11	2	40			9	2
GR (11)	55		9	18						18
HR (29)	31			14	7	7		7	21	14
HU (12)		17		17		58		8		
IE (9)	11	11		22		33		22		
IT (47)	6	6	13	28		34		11		2
LT (10)				10	20	10		10	50	
LU (7)	14					71		14		
LV (12)					8	58			25	8
MT (1)								100		
NL (9)				11		22	22	33	11	
PL (20)	10	15		30	10	30		5		
PT (18)	39	28		17		17				
RO (28)	93	7								
SE (38)	11	5				66	3	11	5	
SI (19)	37	16			5	37			5	
SK (23)	30	9		30	30					

Source: European Environment Agency – April 2021

Notes: FV = good, U1 = poor, U2 = bad, XX = unknown conservation status '-' = deteriorating, '+' = improving, '=' = stable, 'x' = unknown conservation status trend; number of assessments per Member State shown in brackets.

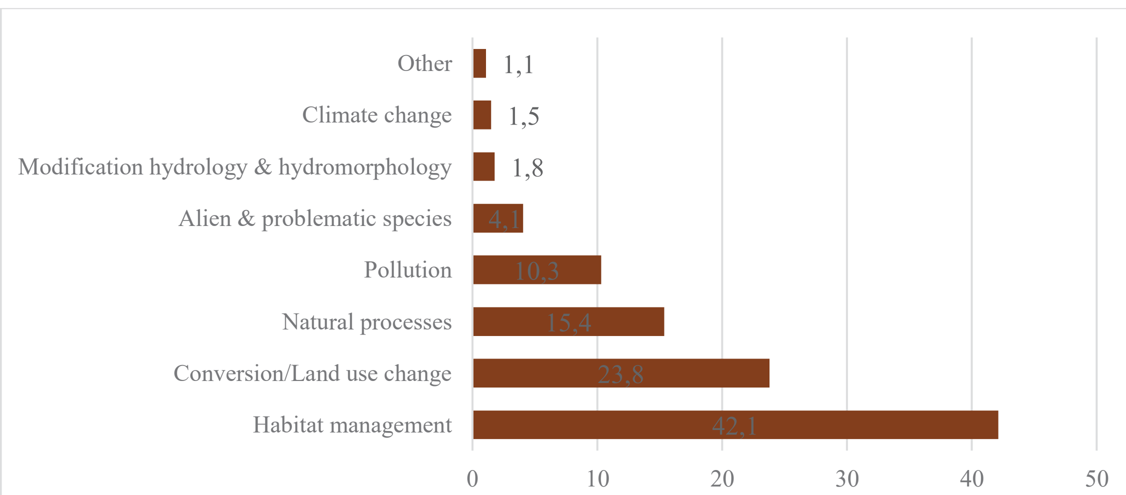
Pressures

Agricultural habitats and grasslands are subject to a wide diversity of pressures resulting in their degradation and extirpation. According to Member States reports under Article 17 of the Habitats Directive, the top three groups of pressures (in percentage of the total) are:

- **Habitat management** with over **42 %** of all pressures; these include inadequate agricultural practices like intensive grazing (18 %), under grazing (12 %), forestry like logging and removal of dead and old trees (44 %); however, over half of these pressures result from abandonment of grassland management (49 %)
- **Conversion and land use change** amounts to **24 %**; from these, over one-third (35 %) is originated from agriculture intensification, conversion to forest (23 %), and construction of urban, industrial and leisure sites (28 %)
- **Natural processes**, with over **15 %**; this is mainly due to natural succession (83 %), which is often due to abandonment of agricultural activities

Equally important is **pollution** with over to **10 %**, mainly originating from agriculture (73 %) or from mixed sources (25 %).

Figure 3 – Pressures reported for agricultural habitats and grasslands (in percentage)



Note: based on pressures reported as 'high-ranking'.

Condition of habitats

Member States reported on the condition of habitat types under Article 17 of the Habitats Directive. This data can be used to estimate the area of agricultural habitats and grasslands assessed as degraded (condition not-good) therefore, requiring restoration.

The area of agricultural habitats and grasslands that would need to be restored, i.e., improved condition, is **at least 31 180 km^2**, representing **18 %** of the total area reported for this group of habitats (the values exclude Romania). However, the condition of habitats reported as 'unknown' (or not reported) is over 62 100 km^2 (35 % of the total area). This means that the area requiring restoration is bigger than 31 180 km^2; for example, assuming that half of the 'unknown' area is in a not-good condition, the area to be restored would be over 61 000 km^2 or 93 000 km^2 if all the 'unknown' is assumed to be in a 'not-good' condition (18 % of the total area). Table 6 gives information for each of the 35 agricultural habitats and grasslands (excluding Romania) and Table 7 the condition areas and percentage for each of the Member States.

In addition to the habitat condition, Member States also reported on the 'favourable reference areas'[5]. Comparing this area with the actual habitat area allows to estimate how much area of the habitat would need to be re-created to achieve a good distribution and area of the habitat. Based on this data, it is estimated that a **strict minimum** of **2 400 km^2** would need to be **re-created** to achieve a ‘favourable area’:

- 5 km^2 for coastal and dune habitats
- 204 km^2 for heath and scrub habitats
- 2 145 km^2 for grasslands, dehesas and wooded meadows

However, these values are much higher since several Member States did not provide enough information in their reports to allow a more realistic estimation.

[5] The surface area in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the habitat type; this should include necessary areas for restoration or development for those habitat types for which the present coverage is not sufficient to ensure long-term viability.

Table 6 – Condition of agricultural habitats and grasslands per Annex I habitat type

		Condition (area in km2)			Condition (in percentage)		
	Habitat area	**Good**	**Not-good**	**Unknown**	**Good**	**Not-good**	**Unknown**
Total	**177 441**	**84 154**	**31 183**	**62 104**	**47**	**18**	**35**
Coastal and dune habitats	**365**	**242**	**97**	**26**	**66**	**27**	**7**
1630	334	218	90	26	65	27	8
21A0	31	24	7		77	23	
Heath and scrub habitats	**29 493**	**11 040**	**2 618**	**15 835**	**37**	**9**	**54**
4030	15 156	5 373	1 789	7 994	35	12	53
4040	17	8	2	7	45	12	43
4090	12 033	3 995	606	7 432	33	5	62
5130	941	506	153	283	54	16	30
5430	270	241	1	28	89		10
8240	1 076	918	68	91	85	6	8
Grasslands	**115 616**	**50 530**	**26 218**	**38 867**	**44**	**23**	**34**
6110	987	425	84	478	43	9	48
6120	124	24	65	36	19	52	29
6130	17	11	1	5	64	7	29
6140	1 106			1 106			100
6150	10 776	8 360	73	2 343	78	1	22
6160	413	212	45	156	51	11	38
6170	9 009	3 747	322	4 940	42	4	55
6180	180	30	130	20	17	72	11
6190	41	13	3	24	33	8	59
6210	11 255	4 176	1 066	6 013	37	9	53
6220	30 441	9 350	3 403	17 688	31	11	58
6230	3 728	1 865	587	1 276	50	16	34
6240	394	97	116	181	25	29	46
6250	346	64	126	156	18	36	45
6260	413	124	241	48	30	58	12
6270	1 947	924	855	168	47	44	9
6280	436	276	129	30	63	30	7
62A0	6 295	1 040	131	5 124	17	2	81
62B0					100		
62C0	77			77			100
62D0	345			345			100
6410	2 806	579	468	1 759	21	17	63
6420	556	159	91	307	29	16	55
6510	21 978	8 392	8 058	5 528	38	37	25
6520 (*)	11 945	10 663	10 224	-8 941	89	86	-75
Dehesas & wooded meadows	**31 968**	**22 342**	**2 249**	**7 376**	**70**	**7**	**23**
6310	31 079	21 923	1 831	7 325	71	6	24
6530	70	25	36	10	35	51	14
9070	818	394	383	41	48	47	5

Source: European Environment Agency – April 2021

Notes: Areas reported by Romania excluded from the table; (*) issue with data for habitat 6520 in the Mediterranean region of France (total area reported as both 'good' and 'not-good')

Table 7 – Condition of Annex I agricultural habitats and grasslands per Member State

	Habitats area (km^2)				Percentage		
Member State	**Total**	**Good**	**Not-good**	**Unknown**	**Good**	**Not-good**	**Unknown**
AT	6 240	4 488	22	1 729	72		28
BE	218	48	99	72	22	45	33
BG	3 344			3 344			100
CY	15	8	4	3	54	24	21
CZ	1 876	1 127	227	522	60	12	28
DE	3 111	2 285	665	161	73	21	5
DK	507	173	334		34	66	
EE	460	305	93	63	66	20	14
ES	79 158	36 396	6 536	36 226	46	8	46
FI	400	309	18	74	77	4	18
FR (#)	24 401	15 838	14 428	-5 864	65	59	-24
GR	4 615	3 914	52	650	85	1	14
HR	6 794	508	102	6 184	7	2	91
HU	1 275	467	607	201	37	48	16
IE	1 626	1 016	611		62	38	
IT	17 222	4 913	590	11 719	29	3	68
LT	606	344	140	123	57	23	20
LU	149	28	122		18	81	
LV	347		122	224		35	65
MT	10	5	5		49	51	
NL	255	124	126	5	49	49	2
PL	8 170	3 774	4 218	179	46	52	2
PT	3 987	30	130	3 827	1	3	96
RO (*)	54 123	40 475	2 500	11 148	75	5	21
SE	8 984	6 836	1 585	563	76	18	6
SI	1 453	1 137	306	10	78	21	1
SK	2 217	83	43	2 091	4	2	94

Notes: (*) areas reported by Romania largely overestimated; (#) issue with data for habitat 6520 in the Mediterranean region of France (total area reported as both 'good' and 'not-good')

Carbon stock and sequestration

Generally carbon sequestration rates in agricultural and grassland habitats are estimated to be rather low (<1.5 Mg C ha-1 yr-1). Only coastal and halophytic habitats (1630) show relative high sequestration rates but as they cover less than 0,2% of the habitat area their contribution remains small. Despite the low carbon uptake rates, carbon stocks are relatively high as significant amounts of carbon are accumulated in soils and in some habitat types also in the vegetation. Covering almost 4.3% of the EU-27 territory agricultural and grassland habitats sequester around 13,7 Mio tons of carbon equivalent to 50 Mio tons of CO_2 if habitats are in good condition. As such sequestration rates per km^2 are similar to wetlands but storage capacity is significant lower. Carbon stocks are estimated to range between 0,6 and 2,8 Gt C equivalent to 2,2 – 10,3 Gt of CO_2 which is only 60% of the storage capacity of wetlands despite these habitats cover 30% more land.

Table 8 – Carbon stock and sequestration of Annex I agricultural habitats and grasslands

EU27 excluding Romania	Area (km^2)	Total Carbon Stock (Mt)		Potential carbon sequestration rate (Mt y^{-1})
		min	max	mean
Coastal and dune habitats	**364.58**	**0.00**	**2.73**	**0.10**
1630	333.70	0.00	2.50	0.10
21A0	30.88	0.00	0.23	0.00
Heath and scrub habitats	**29 492.68**	**120.86**	**344.06**	**2.21**
4030	15 155.66	113.67	227.33	1.14
4040	16.87	0.13	0.25	0.00
4090	12 032.57	0.00	90.24	0.90
5130	941.33	7.06	14.12	0.07
5430	269.96	0.00	4.05	0.02
8240	1 076.29	0.00	8.07	0.08
Grasslands	**113 531.31**	**368.10**	**1 871.71**	**9.07**
6110	987.26	0.00	7.40	0.07
6120	124.08	0.00	1.86	0.01
6130	17.41	0.00	0.13	0.00
6140	1 105.61	8.29	24.88	0.08
6150	10 776.08	0.00	161.64	0.81
6160	412.89	0.00	6.19	0.03
6170	9 009.50	0.00	67.57	0.68
6180	180.00	1.35	4.05	0.01
6190	40.52	0.00	0.30	0.00
6210	10 971.04	0.00	164.57	0.82
6220	28 678.38	0.00	430.18	2.15
6230	3 727.97	0.00	55.92	0.28
6240	393.78	2.95	5.91	0.03
6250	346.03	0.00	2.60	0.03
6260	412.66	0.00	3.09	0.03
6270	1 946.85	14.60	43.80	0.15
6280	435.50	3.27	6.53	0.03

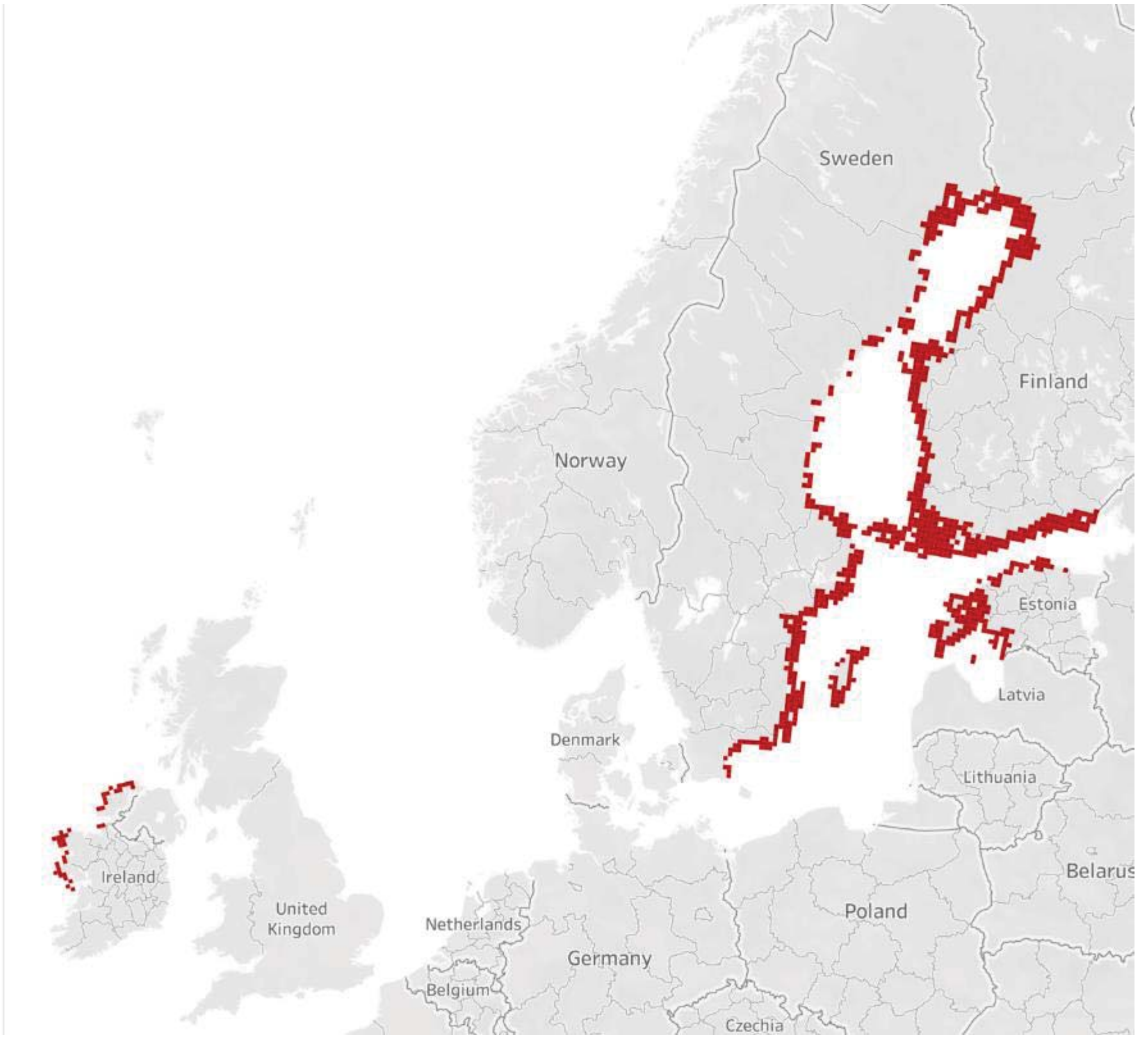
Source: European Environment Agency – April 2021

EU27 excluding Romania	Area (km^2)	Total Carbon Stock (Mt)		Potential carbon sequestration rate (Mt y^{-1})
		min	max	mean
62A0	6 295.29	0.00	94.43	0.47
62B0	0.42	0.00	0.00	0.00
62C0	76.83	0.00	0.58	0.01
62D0	344.95	2.59	5.17	0.03
6410	2 806.08	21.05	63.14	0.21
6420	556.22	4.17	12.52	0.04
6510	21 940.53	220.24	440.48	2.20
6520	11 945.43	89.59	268.77	0.90
Dehesas and wooded meadows	**30 253.78**	**28.00**	**66.66**	**0.18**
6310	29 365.22	21.33	53.33	0.11
6530	70.16	0.53	1.05	0.01
9070	818.40	6.14	12.28	0.06
TOTAL	**173 642.35**	**516.96**	**2 285.16**	**11.56**

Note: areas reported by Romania note included

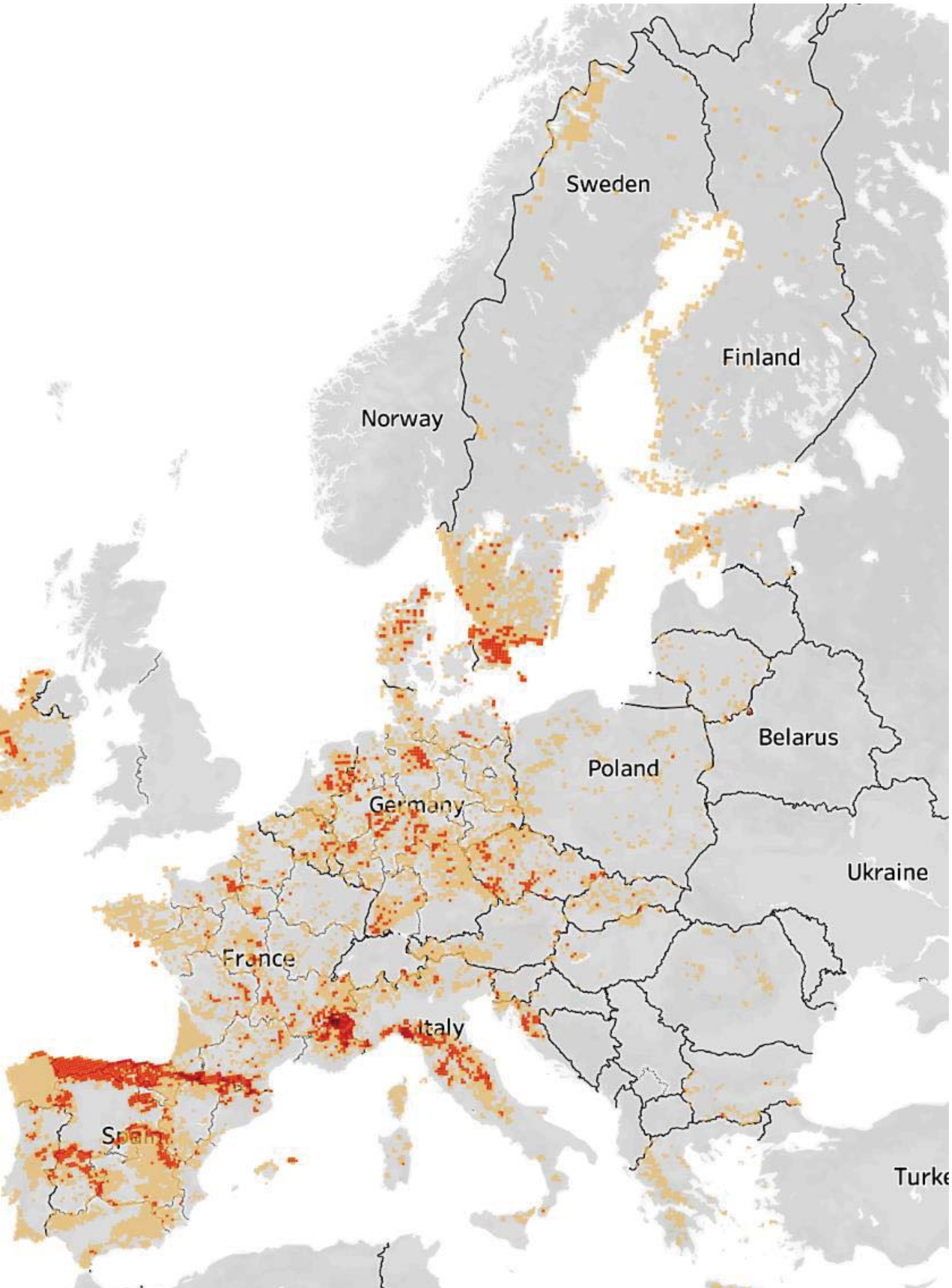
Annex A

Map 2 – Distribution of Annex I coastal and dune habitats (agricultural habitats and grasslands) (1630, 21A0)



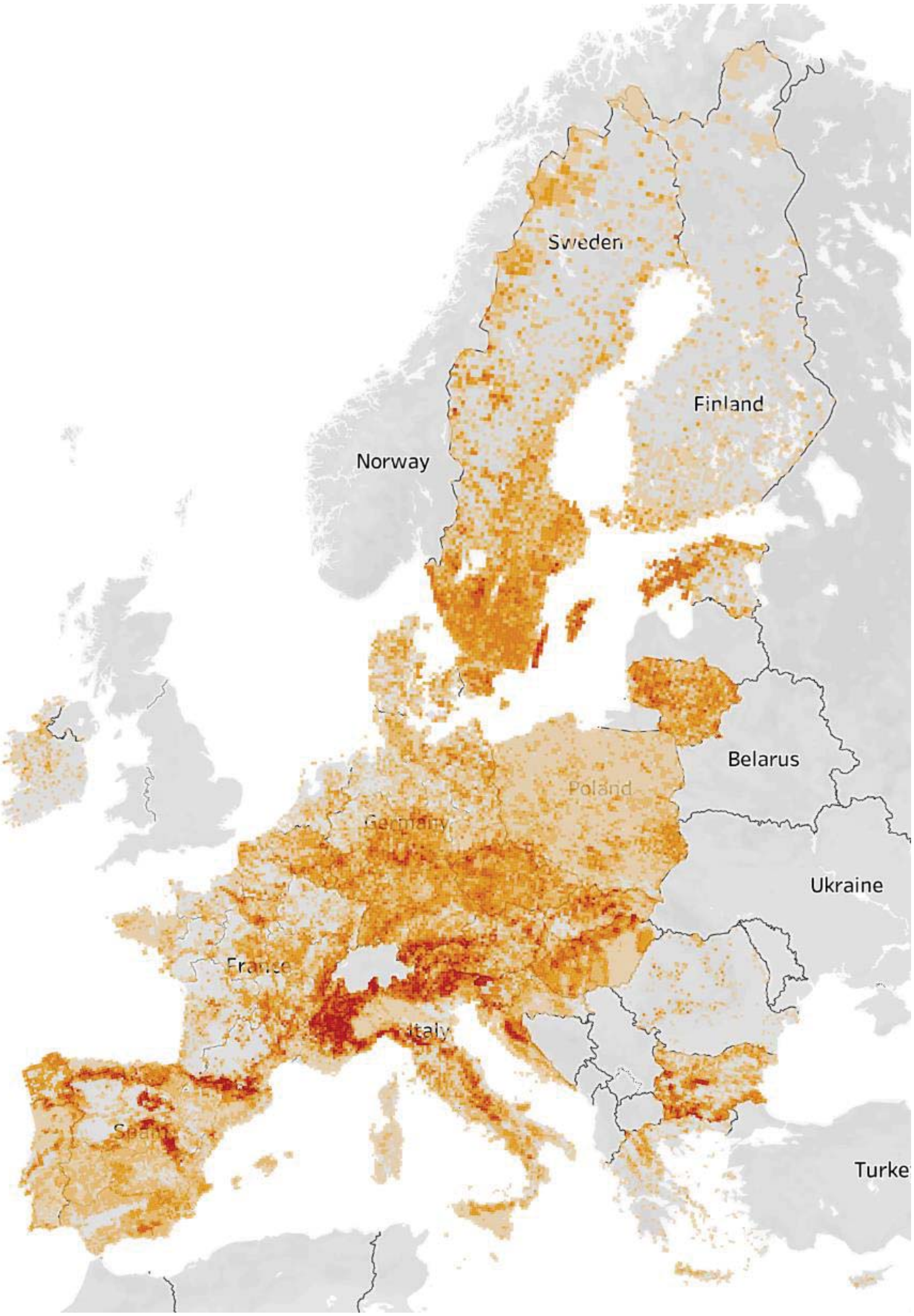
Source: European Environment Agency – April 2021

Map 3 – Distribution of Annex I heath and scrub habitats (agricultural habitats and grasslands) (4030, 4040, 4090, 5130, 5430, 8240)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell. Macaronesian islands not shown in the map.

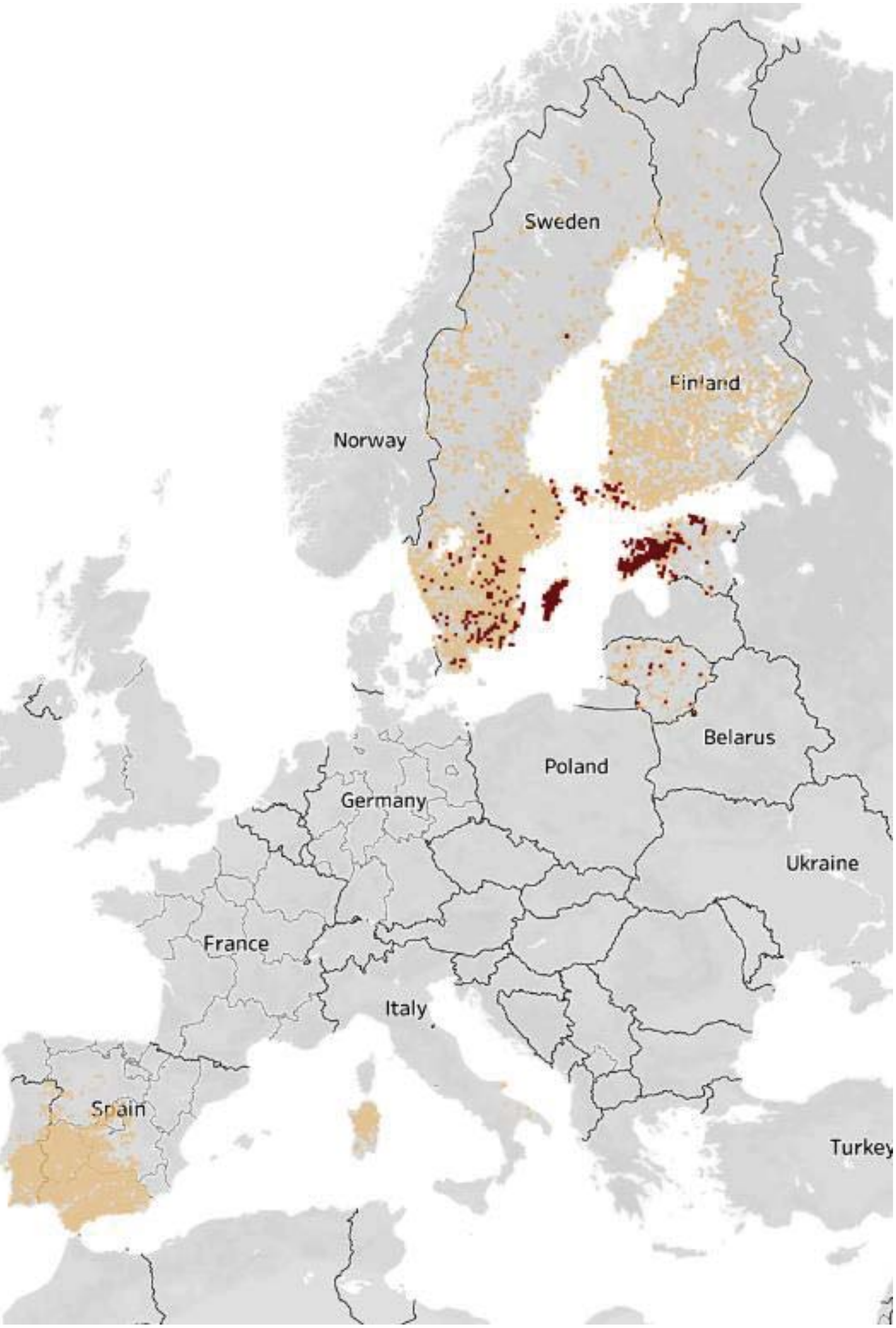
Map 4 – Distribution of Annex I grasslands (6110-6190, 6210-62D0, 6410, 6420, 6510, 6520)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell. Macaronesian islands not shown in the map.

Source: European Environment Agency – April 2021

Map 5 – Distribution of Annex I dehesas and wooded meadows (agricultural habitats and grasslands) (6310, 6530, 9070)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell. Macaronesian islands not shown in the map.

Source: European Environment Agency – April 2021

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SWD(2022) 167 final

PART 9/12

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

ANNEX VIII-d

Accompanying the

proposal for a Regulation of European Parliament and of the Council

on nature restoration

{COM(2022) 304 final} - {SEC(2022) 256 final} - {SWD(2022) 168 final}

EN EN

Table of Contents

Annex VIII-d: STEPPE, HEATH and SCRUB HABITATS

Introduction

This paper provides information derived from the Member States' reports and assessments under Article 17 of the Habitats Directive. It is a background information to help identify possible restoration targets for the 'legal binding instrument' under the EU Biodiversity Strategy to 2030.

The 'steppe, heath and scrub' group include, 21 Annex I habitat types (see Table 1): all heaths and scrubs (except wet heaths[1] and those dependent on agricultural management[2]), and a selection of steppe habitats.

Table 1 – Steppe, heath and scrub Annex I habitat types selected

Salt and gypsum steppes (3 types)		**Sclerophyllous scrub (matorral) (11 types)**	
1430	Halo-nitrophilous scrubs (*Pegano-Salsoletea*)	5110	Stable xerothermophilous formations with *Buxus sempervirens* on rock slopes (*Berberidion* p.p.)
1510	Mediterranean salt steppes (*Limonietalia*)	5120	Mountain *Cytisus purgans* formations
1520	Iberian gypsum vegetation	5140	*Cistus palhinhae* formations on maritime
Temperate heath and scrub (7 types)		5220	Arborescent matorral with *Zyziphus*
4050	Endemic macaronesian heaths	5230	Arborescent matorral with *Laurus nobilis*
4060	Alpine and Boreal heaths	5310	Laurus nobilis thickets
4070	Bushes with *Pinus mugo* and	5320	Low formations of *Euphorbia* close to cliffs
4080	Sub-Arctic *Salix* spp. scrub	5330	Thermo-Mediterranean and pre-desert scrub
40A0	Subcontinental peri-Pannonic scrub	5410	West Mediterranean clifftop phryganas (*Astragalo-Plantaginetum subulatae*)
40B0	Rhodope *Potentilla fruticosa* thickets	5420	*Sarcopoterium spinosum* phryganas
40C0	Ponto-Sarmatic deciduous thickets	5430	Endemic phryganas of the *Euphorbio-Verbascion*

[1] Included in the group 'wetlands'

[2] Included in the group 'agricultural habitats and grasslands'

'Steppe, heath and scrub habitats' coverage in the EU

The 21 habitat types selected cover close to **78 582 km²** (**2 %** of the EU terrestrial area[3]); this excludes areas reported by Romania, which are known to be largely overestimated[4].

The data available from Corine Land Cover[5] and from the Ecosystems Map of Europe[6] do not allow a straightforward comparison between the total area of 'steppe, heath and scrub habitats' in the EU and the area covered by Annex I habitats. This is mainly due to the nomenclatures used and the spatial resolution of the datasets. A comparison between these data sources is given in Table 2 below.

Table 2 – Heath and scrub land (km²) from different sources (EU27)

Corine Land Cover 2018 (level 3)

Scrub and/or herbaceous vegetation associations	**163 270**
322 – Moors and heathland	71 269
323 – Sclerophyllous vegetation	92 001

Ecosystems map (level 3)

F – Heathland, scrub and tundra	**114 777**
F2 – Arctic, alpine and subalpine scrub	21 095
F3 – Temperate and mediterranean-montane scrub	21 331
F4 – Temperate shrub heathland	2 230
F5 – Maquis, arborescent matorral and thermo-Mediterranean brushes	41 459
F6 – Garrigue	10 701
F7 – Spiny Mediterranean heaths (phrygana, hedgehog-heaths and related coastal cliff vegetation)	17 007
F8 – Thermo-Atlantic xerophytic scrub	954

[3] Area of habitats calculated from the area reported by Member States as 'best estimate' or 'average of minimum/maximum'

[4] The average total area of agri-habitats and grasslands habitats reported by Romania is 2 312 km²

[5] https://www.eea.europa.eu/data-and-maps/dashboards/land-cover-and-change-statistics

[6] https://www.eea.europa.eu/themes/biodiversity/mapping-europes-ecosystems

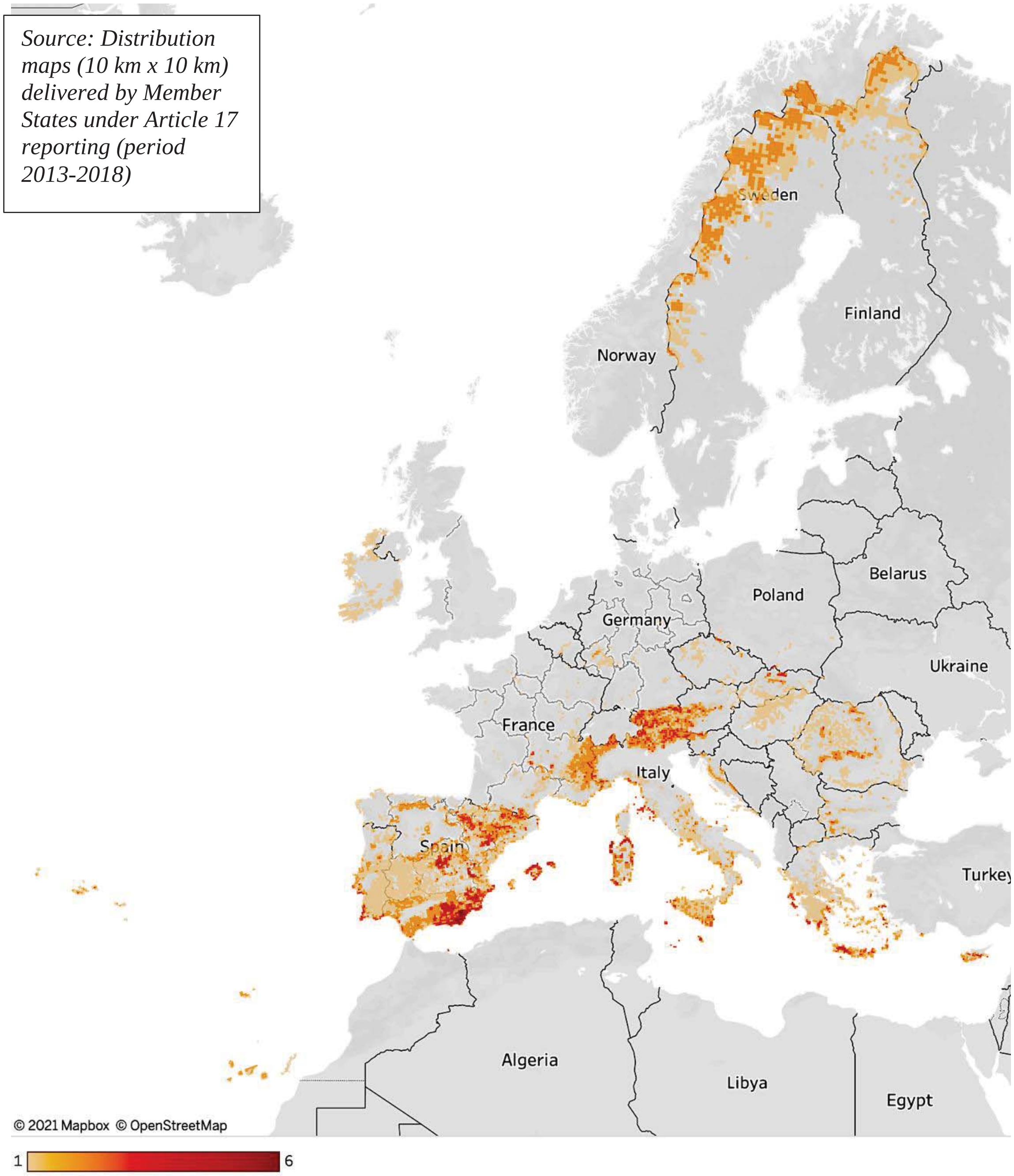
The areas of steppe, heath and scrub habitats are mainly present in the Mediterranean region and most mountain ranges, including those of Fennoscandia (see Map 1). The Member States with the highest proportion of those habitats are Greece (7 %), Malta (6 %), Spain (5 %), Sweden (4 %) and Austria (6 %); sixteen Member States have less than 2 % of their territory covered by steppes, heaths and scrubs; these habitats are absent in five Member States (Denmark, Estonia, Latvia, Lithuania and the Netherlands).

Table 3 gives the areas and proportion of steppe, heath, and scrub habitats for each Member State, including coverage by Natura 2000. Maps illustrating the distribution of different types of these habitats in the EU are available in Annex A.

From the **78 582 km^2** of steppe, heath, and scrub habitats (excluding Romania), about **48 %** is estimated to be inside the Natura 2000 network (about **37 607 km^2**); this may be an underestimation since reports from Member States were not comprehensive on this regard. The coverage by Natura 2000 varies according to the sub-group, **from 49 %** for 'temperate heaths' **to 38 %** for 'salt and gypsum steppes'. The proportion of habitats per sub-group of 'steppe, heath and scrub' habitats and their coverage is detailed in Table 4.

Coverage by Natura 2000 also greatly varies according to the Member State: **from over 90 %** (Bulgaria, Czechia, Luxembourg, Portugal, Slovakia and Slovenia) **to less than 25 %** (France) (Table 3).

Map 1 – Distribution of the 21 Annex I steppe, heath, and scrub habitats in the EU



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell.

Table 3 – Area and proportion of steppe, heath, and scrub habitats per Member State

	Member State area (km^2)	In the Member State		Proportion of the Steppe, heath & scrub area (%)	Inside Natura 2000	
		Steppe, heath & scrub area (km^2)	Steppe, heath & scrub area (%)		Steppe, heath & scrub area	% Steppe, heath & scrub area
Austria	83 944	3 584.9	4.3	4.6	989.254	27.6
Belgium	30 683	0.3	0.0	0.0	0.16	61.5
Bulgaria	110 995	671.8	0.6	0.9	653.25651	97.2
Croatia	55 590	1066.1	1.9	1.4	653.25651	61.3
Cyprus	9 249	160.2	1.7	0.2	119.19	74.4
Czechia	78 874	20.3	0.0	0.0	19.92692	98.2
Denmark	44 162					
Estonia	45 382					
Finland	338 004	6 711.0	2.0	8.5	5978	89.1
France	551 881	6 758.1	1.2	8.6	1150.76	17.0
Germany	362 177	155.9	0.0	0.2	96.6678	62.0
Greece	132 014	9 037.6	6.8	11.5	2876.28	31.8
Hungary	93 012	10.0	0.0	0.0	8	80.0
Ireland	70 699	150.7	0.2	0.2	116.25	77.1
Italy	301 321	4628.811	1.5	5.9	2007.47714	43.4
Latvia	64 590					
Lithuania	65 289					
Luxembourg	2 595	0.1	0.0	0.0	0.0531	99.3
Malta	316	19.9	6.3	0.0	13.2143	66.4
Netherlands	39 898					
Poland	312 683	41.5	0.0	0.1	32.4572	78.3
Portugal (#)	92 378	1 185.6	1.3	1.5	1582.16	133.4
Romania (*)	*238 404*	2 312.1	1.0		1697.7612	73.4
Slovakia	49 026	125.4	0.3	0.2	121.8334	97.2
Slovenia	20 274	238.0	1.2	0.3	233	97.9
Spain	506 222	24 100.7	4.8	30.7	10997.062	45.6
Sweden	450 110	19 915.0	4.4	25.3	9959	50.0
Total	4 149 772	**80 893.7**	**1.9**		**39 305.0**	**48.6**
Total (without Romania)	**3 911 772**	**78 581.6**	**2.0**		**37 607.3**	**47.9**

Source: European Environment Agency – April 2021

Notes: Member States with more than 2 % (the EU average) of their terrestrial area covered by 'steppe, heath and scrub' habitats are highlighted; (*) areas reported by Romania are overestimated; (#) Portugal reported areas inside Natura 2000 but not overall for several habitats, which explain the abnormal figure of 133 % coverage by the network.

Table 4 – Area and proportion of steppe, heath, and scrub habitats per sub-group

		Inside Natura 2000	
EU27 excluding Romania	**Area (km²)**	**Steppe, heath, & scrub area (km²)**	**% Steppe, heath & scrub area**
Salt and gypsum steppe	**2 509**	**965**	**38**
1430	651	256	39
1510	307	85	28
1520	1 551	624	40
Temperate heath	**42 183**	**20 829**	**49**
4050	1 295	501	39
4060	37 481	18 676	50
4070	1 985	920	46
4080	1 385	701	51
40A0	37	31	85
40B0	0.03	0.03	100
40C0	0.03	0.03	100
Sclerophyllous scrub	**33 890**	**15 768**	**47**
5110	2 858	1 782	62
5120	2 674	1 939	73
5140 (*)		45	(100)
5210	7 301	3 575	49
5220	311	119	38
5230	185	27	14
5310	157	1	1
5320	94	40	43
5330	12 418	5 940	48
5410	27	21	76
5420	7 745	2 162	28
5430	3 728	118	98
TOTAL	**78 582**	**37 563**	**48**

Note: (*) total area not reported for this habitat restricted to southwest Portugal, but likely to be fully covered by Natura 2000

Source: European Environment Agency – April 2021

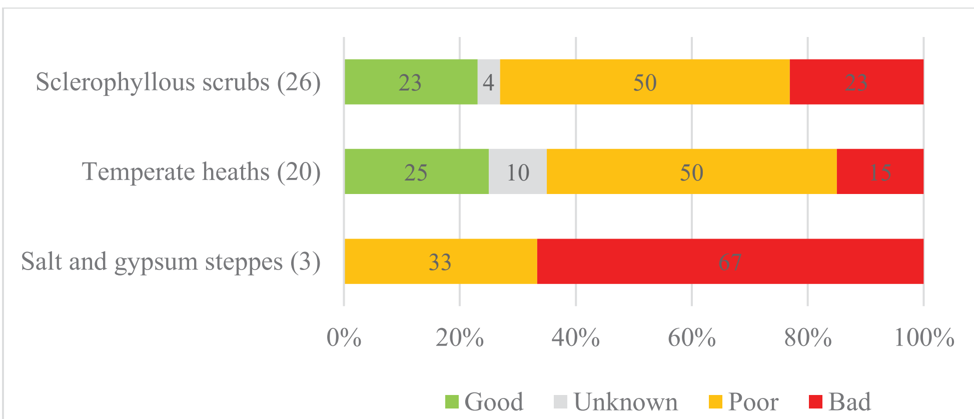
Conservation status and trends

The vast majority (**71 %**) of the assessments of the 21 steppe, heath, and scrub habitats at the EU level have an **unfavourable** conservation status (49 % poor and 22 % bad). **22 %** have a **good** conservation status. There are differences between the different habitat groups (Figure 1): 'temperate heaths' has the highest proportion of good status (25 %) and the 'salt and gypsum steppes' the worst status (100 % unfavourable, but only three habitats in this group).

Among the habitat assessments that do not have a good status, almost one-third have a **deteriorating** trend (**29 %**) while only **3 %** have an improving trend. An additional **39 %** maintain their unfavourable status; the conservation status trend is unknow for **29 %** of the assessments. The group with the worst conservation status trends is **'salt and gypsum steppes' (67 % deteriorating)**; '**temperate heath**' habitats have the higher proportion of **improving** trends (**7** %) (Figure 2).

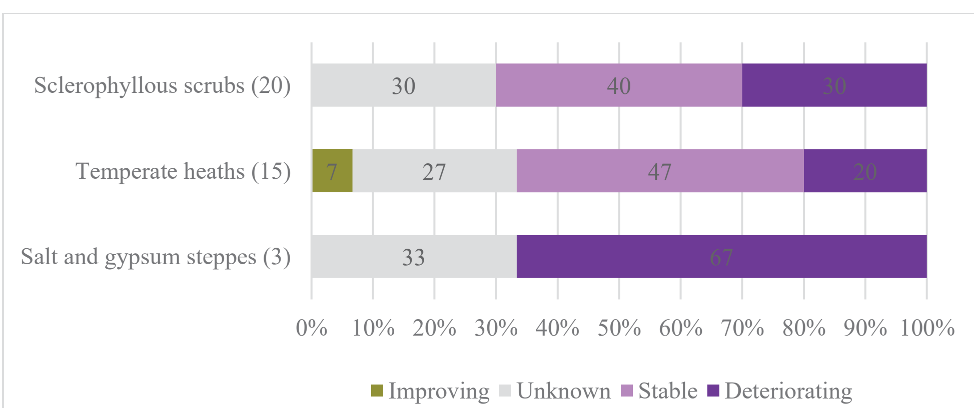
Details on conservation status and conservation status trends for each Member State are given in Table 5.

Figure 1 – Conservation status of steppe, heath, and scrub habitats at the EU level (in percentage)



Note: Number of assessments per group shown in brackets.

Figure 2 – Conservation status trends of steppe, heath, and scrub habitats at the EU level (in percentage)



Note: Number of assessments per group shown in brackets.

Table 5 – Conservation status and trends of steppe, heath, and scrub habitats in the Member States (in percentage)

Member States	FV	U1-	U1+	U1=	U1x	U2-	U2+	U2=	U2x	XX
AT (4)	75				25					
BE (1)				100						
BG (13)				15	85					
CY (5)	40			40					20	
CZ (5)	60			40						
DE (7)	71	14		14						
DK (0)										
EE (0)										
ES (23)	17	4		26	13	4		9	13	13
FI (4)	50	50								
FR (20)	45	15		25		10				5
GR (9)	56		22	11			11			
HR (5)	100									
HU (1)				100						
IE (1)							100			
IT (24)	29	8		33		21		4		4
LT (0)										
LU (1)				100						
LV (0)										
MT (5)	40			20				40		
NL (0)										
PL (7)	29			14				57		
PT (15)	33	27		13		27				
RO (8)	38			63						
SE (4)	100									
SI (2)	100									
SK (5)	80			20						

Source: European Environment Agency – April 2021

Notes: FV = good, U1 = poor, U2 = bad, XX = unknown conservation status '-' = deteriorating, '+' = improving, '=' = stable, 'x' = unknown conservation status trend; number of assessments per Member State shown in brackets.

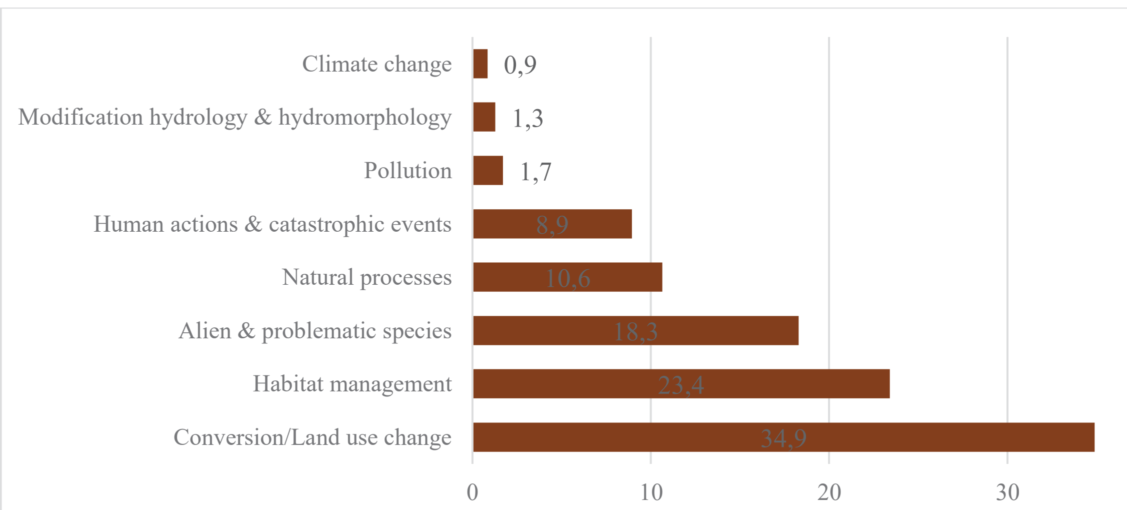
Pressures

Steppe, heath, and scrub habitats are subject to a wide diversity of pressures resulting in their degradation and extirpation. According to Member States reports under Article 17 of the Habitats Directive, the top three groups of pressures (in percentage of the total) are:

- **Conversion and land use change** amounts to near **35 %**; from these, over half (52 %) is due to development of urban, industrial and leisure sites, 26 % from agriculture intensification, 12 % from afforestation, and 9 % from building of roads and railroads
- **Habitat management** with over **23 %** of all pressures; these include inadequate agricultural practices like intensive grazing and ceasing management (73 %), forestry like burning and plantations with non-native species (20 %)
- **Alien and problematic species**, with over **18 %**; this is mainly due to invasive alien species, many of them of EU concern

Equally important are **natural processes** with near **11 %**, mainly originating from natural succession, which is often related to the lack of management of the concerned habitats.

Figure 3 – Pressures reported for steppe, heath and scrub habitats (in percentage)



Note: based on pressures reported as 'high-ranking'.

Condition of habitats

Member States reported on the condition of habitat types under Article 17 of the Habitats Directive. This data can be used to estimate the area of steppe, heath, and scrub habitats assessed as degraded (condition not-good) therefore, requiring restoration.

The area of steppe, heath, and scrub habitats that would need to be restored, i.e., improved condition, is **at least 6 586 km^2**, representing **8 %** of the total area reported for this group of habitats (the values exclude Romania). However, the condition of habitats reported as 'unknown' (or not reported) is almost 28 600 km^2 (36 % of the total area). This means that the area requiring restoration is bigger than 6 586 km^2; for example, assuming that half of the 'unknown' area is in a not-good condition, the area to be restored would be over 20 000 km^2 or 35 000 km^2 if all the 'unknown' is assumed to be in a 'not-good' condition (36 % of the total area). Table 6 gives information for each of the 21 steppe, heath, and scrub habitats (excluding Romania) and Table 7 the condition areas and percentage for each of the Member States.

In addition to the habitat condition, Member States also reported on the 'favourable reference areas'[7]. Comparing this area with the actual habitat area allows to estimate how much area of the habitat would need to be re-created to achieve a good distribution and area of the habitat. Based on this data, it is estimated that a **strict minimum** of **400 km^2** would need to be **re-created** to achieve a ‘favourable area’:

- 11 km^2 for salt and gypsum steppe habitats
- 1 km^2 for temperate heath habitats
- 393 km^2 for sclerophyllous scrub habitats

However, these values are much higher since several Member States did not provide enough information in their reports to allow a more realistic estimation.

[7] The surface area in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the habitat type; this should include necessary areas for restoration or development for those habitat types for which the present coverage is not sufficient to ensure long-term viability

Table 6 – Condition of steppes, heaths, and scrubs per Annex I habitat type

		Condition (area in km2)			Condition (in percentage)		
	Habitat area	Good	Not-good	Unknown	Good	Not-good	Unknown
Total	**78 582**	**43 423**	**6 586**	**28 573**	**55**	**8**	**36**
Salt and gypsum steppe	**2 509**	**373**	**319**	**1 816**	**15**	**13**	**72**
1430	651	55	218	377	8	34	58
1510	307	50	73	184	16	24	60
1520	1 551	267	28	1 256	17	2	81
Temperate heath	**42 183**	**24 591**	**2 951**	**14 640**	**58**	**7**	**35**
4050	1 295	481	753	62	37	58	5
4060	37 481	22 116	2 143	13 222	59	6	35
4070	1 985	901	51	1 033	45	3	52
4080	1 385	1 083	1	300	78		22
40A0	37	11	3	23	29	7	63
40B0	0.03			0.03			100
40C0	0.03			0.03			100
Sclerophyllous scrub	**115 616**	**50 530**	**26 218**	**38 867**	**44**	**23**	**34**
5110	987	425	84	478	43	9	48
5120	124	24	65	36	19	52	29
5140	17	11	1	5	64	7	29
5210	1 106			1 106			100
5220	10 776	8 360	73	2 343	78	1	22
5230	413	212	45	156	51	11	38
5310	9 009	3 747	322	4 940	42	4	55
5320	180	30	130	20	17	72	11
5330	41	13	3	24	33	8	59
5410	11 255	4 176	1 066	6 013	37	9	53
5420	30 441	9 350	3 403	17 688	31	11	58
5430	3 728	1 865	587	1 276	50	16	34

Notes: Areas reported by Romania excluded from the table.

Source: European Environment Agency – April 2021

Table 7 – Condition of Annex I steppes, heaths, and scrubs per Member State

	Habitats area (km²)				Percentage		
Member State	**Total**	**Good**	**Not-good**	**Unknown**	**Good**	**Not-good**	**Unknown**
AT	3 585	3 573	12		100		
BE	0				111	18	62
BG	672			653			97
CY	160	135	26		84	16	
CZ	20	19		1	94	2	4
DE	156	140	16	97	90	10	62
DK							
EE							
ES	24 101	8 685	3 476	11 939	36	14	50
FI	6 711	1 668	1 980	3 063	25	30	46
FR	6 758	341	77	6 341	5	1	94
GR	9 038	7 966	39	1 033	88		11
HR	1 066	1 066			100		
HU	10	7	2	2	65	15	20
IE	151	97	54		64	36	
IT	4 629	1 278	136	3 215	28	3	69
LT							
LU	0.05	0.05			93		7
LV							
MT	20	13	7		66	34	
NL							
PL	41	27	15		65	35	
PT	1 186	242	739	205	20	62	17
RO (*)	2 312	1 629		683	70		30
SE	19 915	17 924		1 992	90		10
SI	238	232	7		97	3	
SK	125	11	3	111	9	2	89

Notes: (*) areas reported by Romania largely overestimated.

Source: European Environment Agency – April 2021

Carbon stock and sequestration

Carbon sequestration rates in steppe, heath and scrub habitats are estimated to be rather low ($<1,5$ Mg C ha^{-1} yr^{-1}). As mineralisation rates in the soils seems to be high carbon stocks also only reach relatively low values (up to 150 Mg C ha^{-1}). Temperate heaths seem to reach slightly higher values than steppe and scrub habitats. Due to their coverage of about 1,7% of EU-27, temperate heaths and sclerophyllous scrubs provide significant contributions to sequestration and stocks of European land ecosystems, compared to salt and gypsum steppes which cover only less than 0,06% of the EU-27 area. Overall, the contribution of these habitats to the carbon sequestration capacity reaches 5,9 Mio tons of carbon equivalent or almost 22 Mio tons of CO_2 if habitats are in good condition. Potential to store carbon is estimated between 0,4 to 1,2 Gt equivalent to 1,4 to 4,3 Gt of CO_2.

Table 8 – Carbon stock and sequestration of Annex I steppe, heath, and scrub habitats

EU27 excluding Romania	Area (km²)	Total Carbon Stock (Mt)		Potential carbon sequestration rate (Mt y⁻¹)
		min	max	mean
Salt and gypsum steppes	**2 508.53**	**0.00**	**37.63**	**0.19**
1430	650.61	0.00	9.76	0.05
1510	307.36	0.00	4.61	0.02
1520	1 550.56	0.00	23.26	0.12
Temperate heaths	**42 182.88**	**316.37**	**632.74**	**3.16**
4050	1 295.17	9.71	19.43	0.10
4060	37 480.68	281.11	562.21	2.81
4070	1 985.01	14.89	29.78	0.15
4080	1 384.95	10.39	20.77	0.10
40A0	37.01	0.28	0.56	0.00
40B0	0.03	0.00	0.00	0.00
40C0	0.03	0.00	0.00	0.00
Sclerophyllous scrub	**33 890.22**	**78.76**	**508.35**	**2.54**
5110	2 857.76	21.43	42.87	0.21
5120	2 673.76	0.00	40.11	0.20
5140*		n.a	n.a	n.a
5210	7 300.89	54.76	109.51	0.55
5220	311.06	0.00	4.67	0.02
5230	185.21	1.39	2.78	0.01
5310	156.99	1.18	2.35	0.01
5320	93.55	0.00	1.40	0.01
5330	12 417.78	0.00	186.27	0.93
5410	27.14	0.00	0.41	0.00
5420	7 745.21	0.00	116.18	0.58
5430	120.88	0.00	1.81	0.01
TOTAL	**78**	**395.13**	**1 178.72**	**5.89**

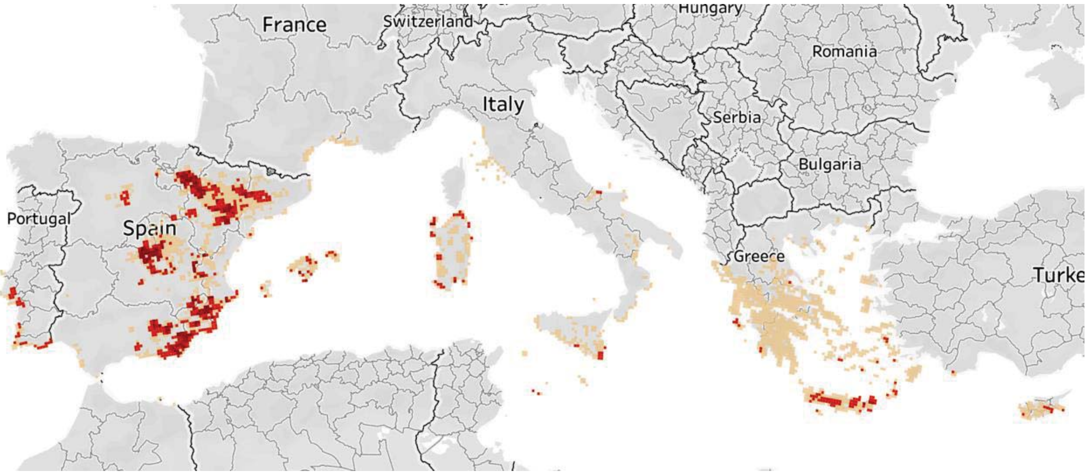
EU27 **excluding Romania**	Area (km²)	Total Carbon Stock (Mt)		Potential carbon sequestration rate (Mt y-1)
		min	max	mean
	581.63			

Note: areas reported by Romania note included; * area not reported

Source: European Environment Agency – April 2021

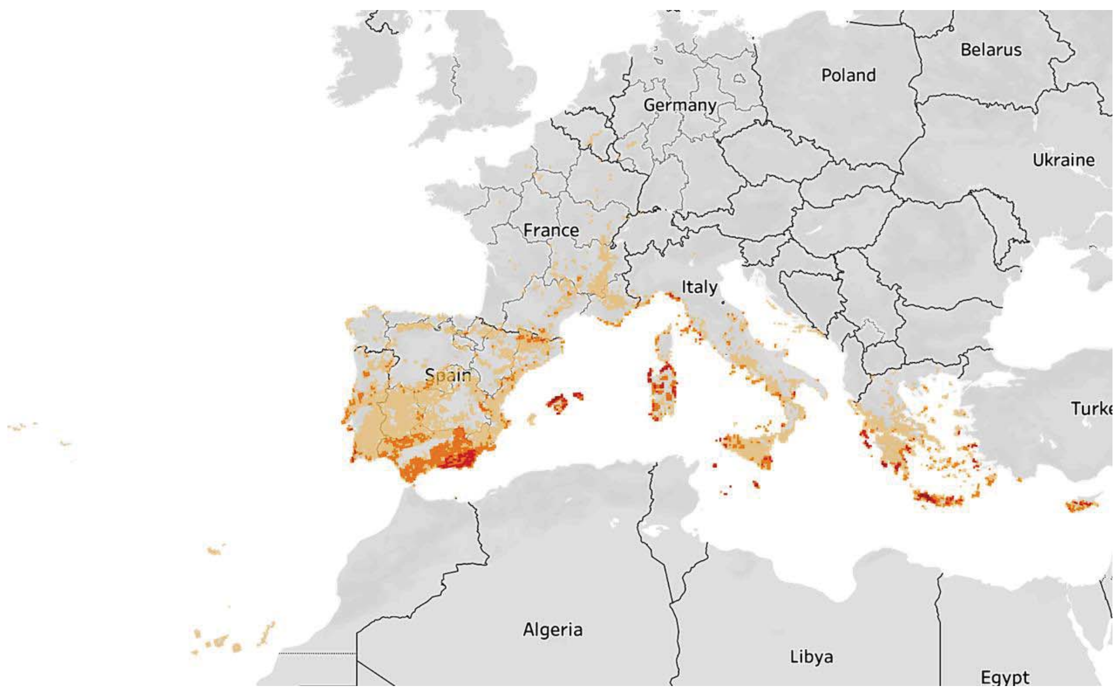
Annex A

Map 2 – Distribution of Annex I salt and gypsum steppes (1430, 1510, 1520)



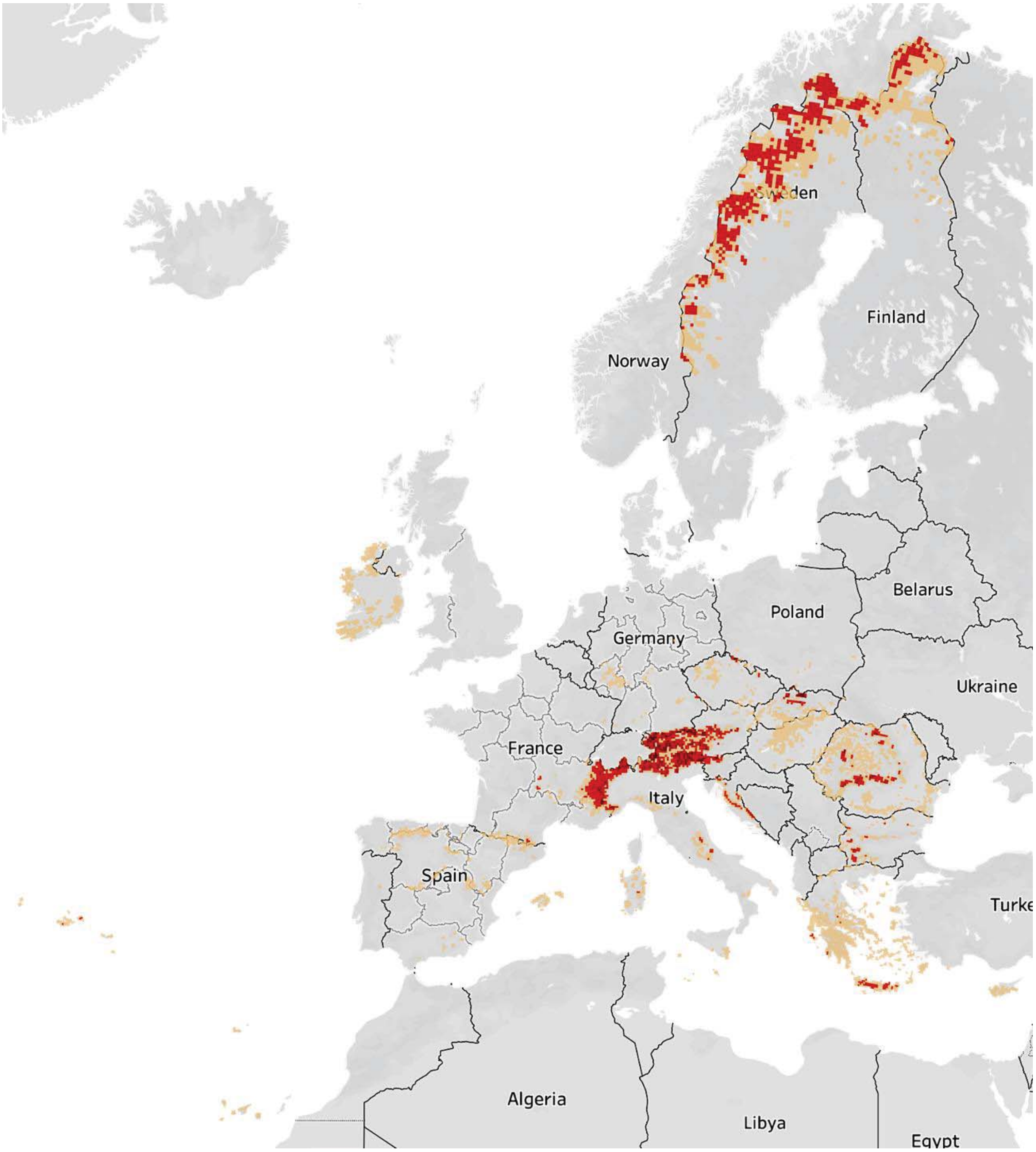
Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell. Macaronesian islands not shown in the map.

Map 3 – Distribution of Annex I sclerophyllous scrub (matorral) (4050, 4060, 4070, 4080, 40A0, 40B0, 40C0)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell.

Map 4 – Distribution of Annex I temperate heath habitats (5110, 5120, 5140, 5220, 5230, 5310, 5320, 5330, 5410, 5420, 5430)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell.

Source: European Environment Agency – April 2021

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PART 10/12

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

ANNEX VIII-e

Accompanying the

proposal for a Regulation of the European Parliament and of the Council

on nature restoration

{COM(2022) 304 final} - {SEC(2022) 256 final} - {SWD(2022) 168 final}

EN EN

Table of Contents

Annex VIII-e: ROCKY AND DUNE HABITATS

Introduction

This paper provides information derived from the Member States' reports and assessments under Article 17 of the Habitats Directive. It is a background information to help identify possible restoration targets for the 'nature restoration law' under the EU Biodiversity Strategy to 2030.

The 'rocky and dune habitats' group include, 41 Annex I habitat types (see Table 1): sea cliffs, beaches, and islets (8 types), coastal and inland dunes (21 types), and rocky habitats (12 types).

Table 1 – Annex I Coastal and dune habitats types selected

Sea cliffs, beaches, and islets (8 types)		**Coastal and inland dunes (cont.)**	
1210	Annual vegetation of drift lines	2250	Coastal dunes with *Juniperus* spp.
1220	Perennial vegetation of stony banks	2260	*Cisto-Lavenduletalia* dune sclerophyllous scrubs
1230	Vegetated sea cliffs of the Atlantic and Baltic Coasts	2270	Wooded dunes with *Pinus pinea* and/or *Pinus pinaster*
1240	Vegetated sea cliffs of the Mediterranean coasts with endemic *Limonium* spp.	2310	Dry sand heaths with *Calluna* and *Genista*
1250	Vegetated sea cliffs with endemic flora of the Macaronesian coasts	2320	Dry sand heaths with *Calluna* and *Empetrum nigrum*
1610	Baltic esker islands with sandy, rocky and shingle beach vegetation and sublittoral vegetation	2330	Inland dunes with open *Corynephorus* and *Agrostis* grasslands
1620	Boreal Baltic islets and small islands	2340	Pannonic inland dunes
1640	Boreal Baltic sandy beaches with perennial vegetation	91N0	Pannonic inland sand dune thicket (*Junipero-Populetum albae*)
Coastal and inland dunes (21 types)		**Rocky habitats (12 types)**	

Source: European Environment Agency – April 2021

2110	Embryonic shifting dunes	8110	Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*)
2120	Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes')	8120	Calcareous and calcshist screes of the montane to alpine levels (*Thlaspietea rotundifolii*)
2130	Fixed coastal dunes with herbaceous vegetation ("grey dunes')	8130	Western Mediterranean and thermophilous scree
2140	Decalcified fixed dunes with *Empetrum nigrum*	8140	Eastern Mediterranean screes
2150	Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)	8150	Medio-European upland siliceous screes
2160	Dunes with *Hippophaë rhamnoides*	8160	Medio-European calcareous scree of hill and montane levels
2170	Dunes with *Salix repens* ssp. argentea (*Salicion arenariae*)	8210	Calcareous rocky slopes with chasmophytic vegetation
2180	Wooded dunes of the Atlantic, Continental and Boreal region	8220	Siliceous rocky slopes with chasmophytic vegetation
2190	Humid dune slacks	8230	Siliceous rock with pioneer vegetation of the *Sedo-Scleranthion* or of the *Sedo albi-Veronicion dillenii*
2210	Crucianellion maritimae fixed beach dunes	8310	Caves not open to the public
2220	Dunes with *Euphorbia terracina*	8320	Fields of lava and natural excavations
2230	*Malcolmietalia* dune grasslands	8340	Permanent glaciers
2240	*Brachypodietalia* dune grasslands with annuals		

'Rocky and dune habitats' coverage in the EU

The 41 habitat types selected cover close to **65 135 km²** (**1.7 %** of the EU terrestrial area[1]); this excludes areas reported by Romania, which are known to be largely overestimated[2].

The data available from Corine Land Cover[3] and from the Ecosystems Map of Europe[4] do not allow a straightforward comparison between the total area of 'rocky and dune habitats' in the EU and the area covered by Annex I habitats. This is mainly due to the nomenclatures used and the spatial resolution of the datasets. A comparison between these data sources is given in Table 2 below.

Table 2 – Rocky and dune land (km²) from different sources (EU27)

Corine Land Cover 2018 (level 3)

Open spaces with little or no vegetation	**62 554**
331 – Beaches, dunes and sand plains	2 966
332 – Bare rocks	20 145
333 – Sparsely vegetated areas	38 200
335 – Glaciers and permanent snow	1 243

Ecosystems map (level 3)

B – Coastal habitats	**2 728**
B1 – Coastal dunes and sandy shores	2 392
B2 – Coastal shingle	41
B3 – Rock cliffs, ledges and shores, including the supralittoral	295
H – Inland unvegetated or sparsely vegetated habitats	**39 811**
H2 – Screes	1 785
H3 – Inland cliffs, rock pavements and outcrops	22 364
H4 – Snow or ice-dominated habitats	1 261
H5 – Miscellaneous inland habitats with very sparse or no vegetation	14 401

The areas of rocky and dune habitats are widely distributed along the EU coast, mountain ranges, and inland sandy plains (see Map 1).

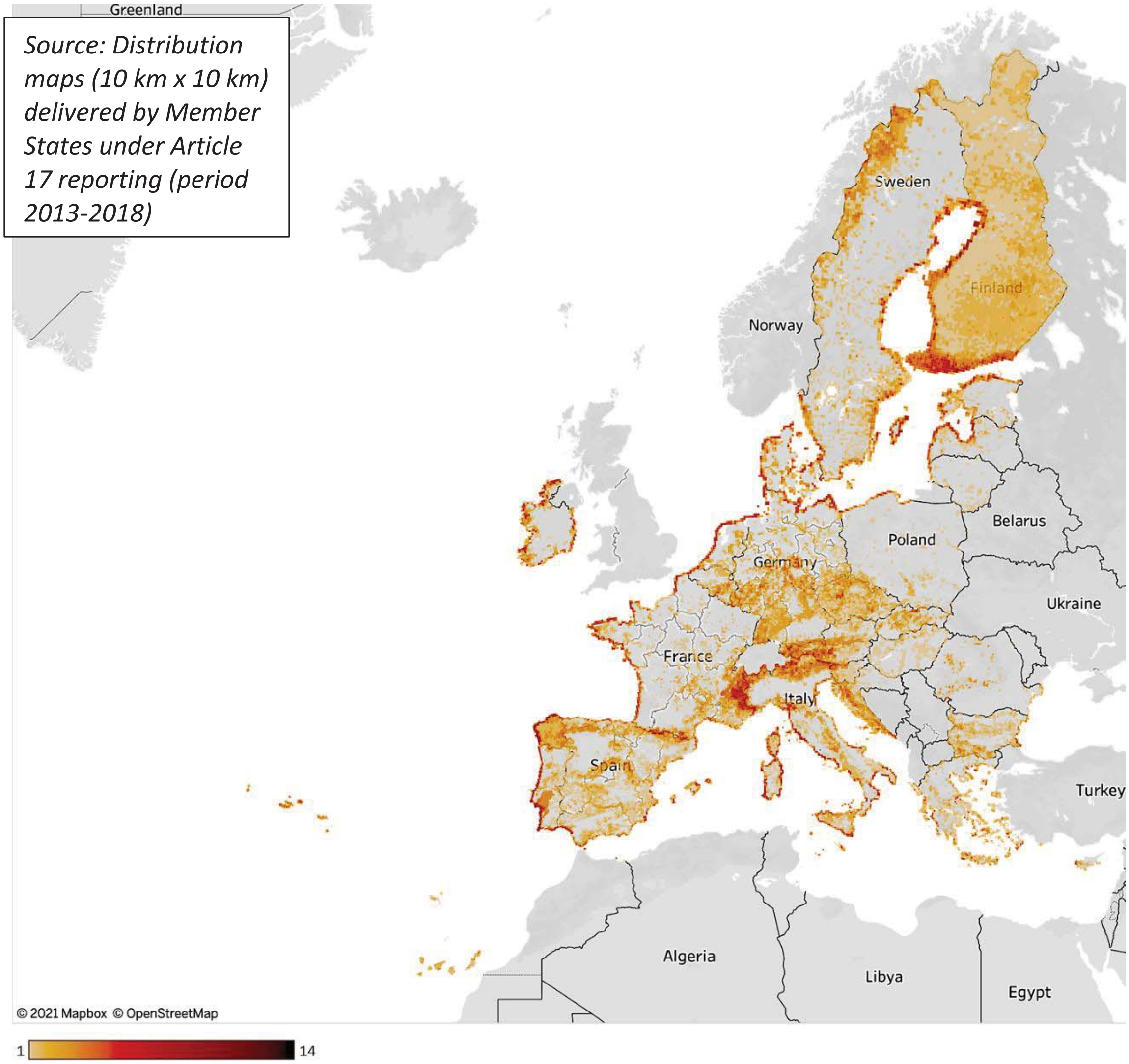
[1] Area of habitats calculated from the area reported by Member States as 'best estimate' or 'average of minimum/maximum'
[2] The average total area of rocky and dune habitats reported by Romania is 61 107 km²
[3] https://www.eea.europa.eu/data-and-maps/dashboards/land-cover-and-change-statistics
[4] https://www.eea.europa.eu/themes/biodiversity/mapping-europes-ecosystems

Table 3 gives the areas and proportion of rocky and dune habitats for each Member State, including coverage by Natura 2000.

From the **65 135 km^2** of rocky and dune habitats (excluding Romania), about **35 %** is estimated to be inside the Natura 2000 network (about **22 686 km^2**); this may be an underestimation since reports from Member States were not comprehensive on this regard. The coverage by Natura 2000 varies according to the sub-group; **72 %** for 'coastal and inland dunes', **30 %** for 'rocky habitats', and **27 %** for sea cliffs and beaches. The proportion of habitats per sub-group of 'rocky and dune' habitats and their coverage is detailed in Table 4.

Coverage by Natura 2000 also greatly varies according to the Member State: **from over 80 %** (Belgium, Croatia, Cyprus, Hungary, Lithuania, Netherlands, Slovakia, and Slovenia) **to less than 25 %** (Finland, and France) (Table 3).

Map 1 – Distribution of the 41 Annex I rocky and dune habitats in the EU



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell.

Table 3 – Area and proportion of rocky and dune habitats per Member State

	Member State area (km^2)	In the Member State		Proportion of the Steppe, heath & scrub area (%)	Inside Natura 2000	
		Steppe, heath & scrub area (km^2)	Steppe, heath & scrub area (%)		Steppe, heath & scrub area	% Steppe, heath & scrub area
Austria	83 944	2 847	3.4	4.4	1 340	47.1
Belgium	30 683	62	0.2	0.1	52	84.1
Bulgaria	110 995	549	0.5	0.8	305	55.6
Croatia	55 590	761	1.4	1.2	639	83.9
Cyprus	9 249	3	0.0	0.0	3	83.3
Czechia	78 874	81	0.1	0.1	40	49.5
Denmark	44 162	631	1.4	1.0	373	59.1
Estonia	45 382	113	0.2	0.2	85	74.8
Finland	338 004	3 868	1.1	5.9	857	22.2
France	551 881	32 467	5.9	49.8	3 280	10.1
Germany	362 177	624	0.2	1.0	480	76.9
Greece	132 014	801	0.6	1.2	467	58.3
Hungary	93 012	235	0.3	0.4	192	81.8
Ireland	70 699	184	0.3	0.3	137	74.2
Italy	301 321	7 633	2.5	11.7	4 484	58.7
Latvia	64 590	629	1.0	1.0	327	52.1
Lithuania	65 289	73	0.1	0.1	65	88.4
Luxembourg	2 595	5	0.2	0.0	3	68.0
Malta	316	43	13.6	0.1	24	57.0
Netherlands	39 898	500	1.3	0.8	457	91.4
Poland	312 683	456	0.1	0.7	178	39.1
Portugal (#)	92 378	595	0.6	0.9	1 434	241.0
Romania (*)	*238 404*	61 107	25.6	93.8	25 939	42.4
Slovakia	49 026	499	1.0	0.8	412	82.6
Slovenia	20 274	754	3.7	1.2	635	84.2
Spain	506 222	5 475	1.1	8.4	4 339	79.3
Sweden	450 110	5 247	1.2	8.1	2 076	39.6
Total	4 149 772	**126 242**	**3.0**		**48 625**	**38.5**
Total (without Romania)	**3 911 772**	**65 135**	**1.7**		**22 686**	**34.8**

Notes: Member States with more than 1 % (the EU average) of their terrestrial area covered by 'rocky and dune' habitats are highlighted; (*) areas reported by Romania are clearly overestimated; (#) Portugal reported areas inside Natura 2000 but not overall for several habitats, which explain the abnormal figure of 241 % coverage by the network.

Table 4 – Area and proportion of rocky and dune per sub-group

		Inside Natura 2000	
EU27 excluding Romania	**Area (km²)**	**Rocky and dune habitats (km²)**	**% Rocky and dune habitats area**
Sea cliffs, beaches and islets	**5 728**	**1 533**	**27**
1210	172	238	(139)*
1220	359	97	27
1230	645	202	31
1240	494	220	44
1250	260	48	19
1610	555	161	29
1620	3 217	557	17
1640	27	10	39
Coastal and inland dunes	**7 376**	**5 314**	**72**
2110	165	125	75
2120	354	287	81
2130	1 322	763	58
2140	312	205	66
2150	72	781	1 079(*)
2160	154	129	84
2170	37	24	65
2180	2 069	875	42
2190	180	136	76
2210	44	33	77
2220	10	5	52
2230	79	66	84
2240	47	51	109(*)
2250	132	115	87
2260	431	284	66
2270	408	368	90
2310	100	79	80

2320	90	63	70
2330	1 304	880	67
2340	13	12	91
91N0	54	31	58
		Inside Natura 2000	
EU27 excluding Romania	**Area (km²)**	**Rocky and dune habitats (km²)**	**% Rocky and dune habitats area**
Rocky habitats	**52 031**	**15 839**	**30**
8110	5 567	2 268	41
8120	2 747	1 099	40
8130	1 827	1 179	65
8140	315	270	86
8150	21	15	72
8160	86	47	54
8210	5 875	3 747	64
8220	6 721	3 576	53
8230	1 134	678	60
8310	25 694	1 548	6
8320	728	575	79
8340	1 316	837	64
TOTAL	**65 135**	**22 686**	**35**

Note: (*) total area not reported for this habitat by Portugal, which reported surface area in Natura 2000

Conservation status and trends

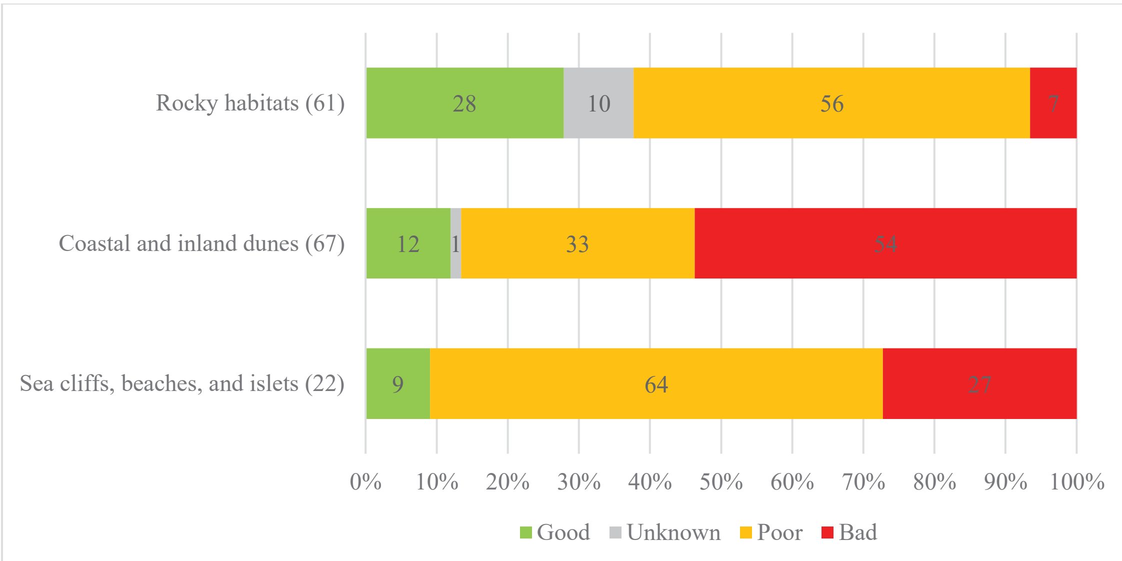
The vast majority (**78 %**) of the assessments of the 41 rocky and dune habitats at the EU level have an **unfavourable** conservation status (47 % poor and 31 % bad). **18 %** have a **good** conservation status. There are differences between the different habitat groups (Figure 1): 'rocky habitats' has the highest proportion of good status (28 %) and the 'sea cliffs, beaches, and islets' the worst status (91 % unfavourable).

Among the habitat assessments that do not have a good status, most have a **deteriorating** trend (**41 %**) while only **7 %** have an improving trend. An additional **33 %** maintain their unfavourable status; the conservation status trend is unknow for **20 %** of the assessments. The group with the worst conservation status trends is **'sea cliffs, beaches, and islets'** (**55 % deteriorating**); '**coastal and inland dune**' habitats have the higher proportion of

improving trends (**10** %), but also a very high proportion of deteriorating trends (54 %) (Figure 2).

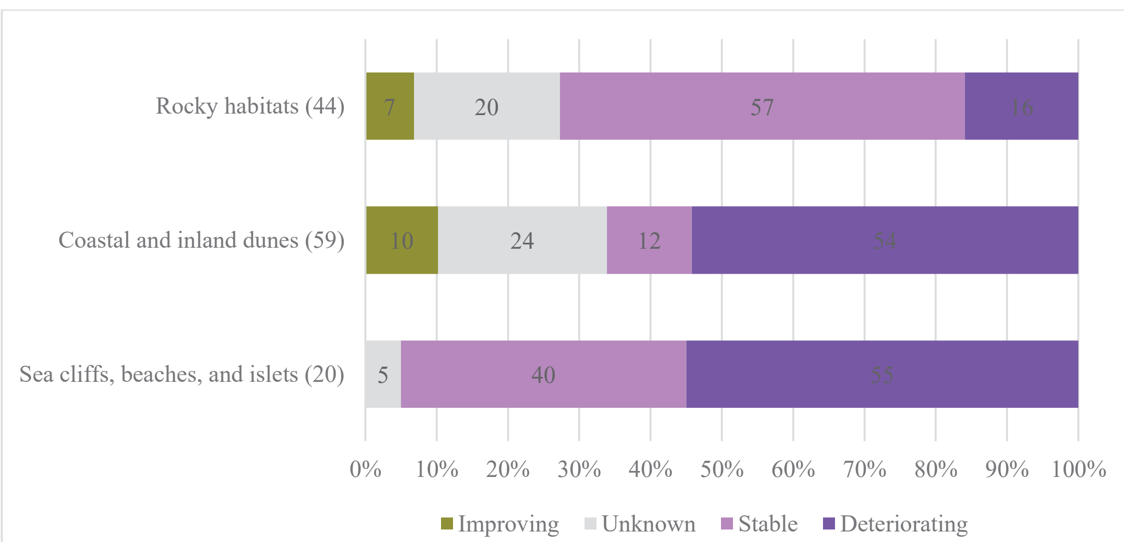
Details on conservation status and conservation status trends for each Member State are given in Table 5.

Figure 1 – Conservation status of rocky and dune habitats at the EU level (in percentage)



Note: Number of assessments per group shown in brackets.

Figure 2 – Conservation status trends of rocky and dune habitats at the EU level (in percentage)



Note: Number of assessments per group shown in brackets.

Table 5 – Conservation status and trends of rocky and dune habitats in the Member States (in percentage)

Member States	FV	U1-	U1+	U1=	U1x	U2-	U2+	U2=	U2x	XX
AT (16)	69				13	6		6	6	
BE (19)	16				5	5	11	32	32	
BG (27)				59	30					11
CY (11)	45			18		18			18	
CZ (15)	73			20		7				
DE (45)	42	11		11	2	27		2	4	
DK (32)	9	6			25	19			41	
EE (16)	81	6		13						
ES (44)	16	7	2	27	16	2		7	11	11
FI (20)	40	25		15		15			5	
FR (60)	30	15		13	13	17		5	3	3
GR (15)	47		7	47						
HR (14)	50	7		7		7		7	7	14
HU (7)	57			14		29				
IE (15)	13	13		67		7				
IT (44)	7	7		50		27		9		
LT (12)	33			8	42				17	
LU (6)	83			17						
LV (16)	25	13	13	25	6	6			6	6
MT (7)	14			14				71		
NL (12)	42			33	8			17		
PL (25)	32	4	8	32		12		4	8	
PT (40)	28	30		8		33				3
RO (21)	86		10	5						
SE (43)	33	5		9	5	12	5	5	28	
SI (12)	67			8	17	8				
SK (16)	81			6	6				6	

Notes: FV = good, U1 = poor, U2 = bad, XX = unknown conservation status '-' = deteriorating, '+' = improving, '=' = stable, 'x' = unknown conservation status trend; number of assessments per Member State shown in brackets.

Pressures

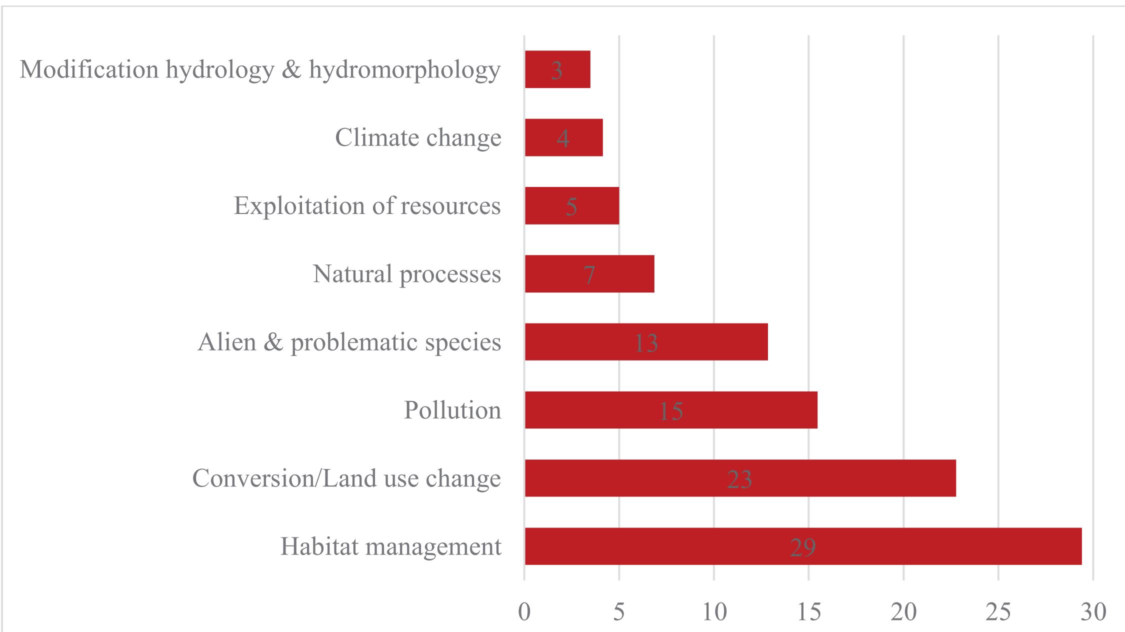
Rocky and dune habitats are subject to a wide diversity of pressures resulting in their degradation and extirpation. According to Member States reports under Article 17 of the Habitats Directive, the top three groups of pressures (in percentage of the total) are:

- **Habitat management** amounts to over **24 %**; from these, over 43 % arise from development of sports, tourism, and leisure activities, near one-third (32 %) is due to abandonment, (on one hand), or intensification (on the other hand) of agricultural practices and, about 14 % from forest management activities

- **Conversion/Land use change** with near **23 %** of all pressures; from these, near 80 % arise from development of housing, industrial and recreational facilities, and coastal protection infrastructures
- **Pollution**, with over **15 %**; this is mainly due to mixed source air and water pollution (36 %), agricultural activities (35 %), and different types of urban, industrial and recreational activities (27 %).

Equally important are **alien & problematic species** with near **13 %**, particularly those species that are not listed in the EU regulation.

Figure 3 – Pressures reported for rocky and dune habitats (in percentage)



Note: based on pressures reported as 'high-ranking'.

Condition of habitats

Member States reported on the condition of habitat types under Article 17 of the Habitats Directive. This data can be used to estimate the area of rocky and dune habitats assessed as degraded (condition not-good) therefore, requiring restoration.

The area of rocky and dune habitats that would need to be restored, i.e., improved condition, is **at least 6 619 km^2**, representing **10 %** of the total area reported for this group of habitats (the values exclude Romania). However, the condition of habitats reported as 'unknown' (or not reported) is about 28 500 km^2 (44 % of the total area). This means that the area requiring restoration is bigger than 6 619 km^2; for example, assuming that half of the 'unknown' area is in a not-good condition, the area to be restored would be over 20 800 km^2 or 35 100 km^2 if all the 'unknown' is assumed to be in a 'not-good' condition (44 % of the total area). Table 6 gives information for each of the 41 rocky and dune habitats (excluding Romania) and Table 7 the condition areas and percentage for each of the Member States.

In addition to the habitat condition, Member States also reported on the 'favourable reference areas'[5]. Comparing this area with the actual habitat area allows to estimate how much area of the habitat would need to be re-created to achieve a good distribution and area of the habitat. Based on this data, it is estimated that a **strict minimum** of **355 km^2** would need to be **re-created** to achieve a ‘favourable area’:

- 22 km^2 for cliffs, beaches, and islets habitats
- 223 km^2 for costal and inland dunes (particularly for priority habitat 'Pannonic inland dunes)
- 111 km^2 for rocky habitats

However, these values are much higher since several Member States did not provide enough information in their reports to allow a more realistic estimation.

[5] The surface area in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the habitat type; this should include necessary areas for restoration or development for those habitat types for which the present coverage is not sufficient to ensure long-term viability.

Table 6 – Condition of rocky and dune habitats per Annex I habitat type

		Condition (area in km2)			Condition (in percentage)		
	Habitat area	**Good**	**Not-good**	**Unknown**	**Good**	**Not-good**	**Unknown**
Total	**65 135**	**30 048**	**6 619**	**28 468**	**46**	**10**	**44**
Sea cliffs, beaches &	**5 728**	**2 367**	**397**	**2 964**	**41**	**7**	**52**
1210	172	76	52	43	45	30	25
1220	359	300	23	36	83	7	10
1230	645	574	65	6	89	10	1
1240	494	414	16	64	84	3	13
1250	260	133	23	104	51	9	40
1610	555	413	68	75	74	12	14
1620	3 217	440	141	2 636	14	4	82
1640	27	18	9	0	66	32	1
Coastal and inland	**7 376**	**2 339**	**1 412**	**3 625**	**32**	**19**	**49**
2110	165	39	18	109	23	11	66
2120	354	157	70	128	44	20	36
2130	1 322	512	513	298	39	39	23
2140	312	204	79	28	65	25	9
2150	72	65	1	6	90	1	8
2160	154	51	10	93	33	6	60
2170	37	11	6	19	31	17	53
2180	2 069	258	207	1 604	12	10	78
2190	180	90	58	32	50	32	18
2210	44	16	9	18	37	22	41
2220	10	9	0	1	90	0	10
2230	79	64	3	12	81	4	15
2240	47	14	32	1	31	68	1
2250	132	73	42	17	55	32	13
2260	431	343	81	7	80	19	2
2270	408	232	122	55	57	30	13
2310	100	36	23	41	36	23	41
2320	90	47	29	14	52	33	15
2330	1 304	99	74	1 131	8	6	87
2340	13	1	0	12	10	4	87
91N0	54	19	35	0	34	65	1
Rocky habitats	**52 031**	**25 343**	**4 810**	**21 878**	**49**	**9**	**42**
8110	5 567	1 593	224	3 750	29	4	67
8120	2 747	1 567	385	795	57	14	29
8130	1 827	1 168	306	352	64	17	19
8140	315	309	0	6	98	0	2
8150	21	12	2	8	54	9	37
8160	86	62	15	10	72	17	11
8210	5 875	2 864	561	2 449	49	10	42

Source: European Environment Agency – April 2021

		Condition (area in km2)			Condition (in percentage)		
	Habitat area	**Good**	**Not-good**	**Unknown**	**Good**	**Not-good**	**Unknown**
8220	6 721	3 783	274	2 663	56	4	40
8230	1 134	242	101	791	21	9	70
8310	25 694	12 885	1 966	10 844	50	8	42
8320	728	567	67	94	78	9	13
8340	1 316	291	909	115	22	69	9

Notes: Areas reported by Romania excluded from the table.

Table 7 – Condition of Annex I rocky and dune habitats per Member State

	Habitats area (km^2)				Percentage		
Member State	**Total**	**Good**	**Not-good**	**Unknown**	**Good**	**Not-good**	**Unknown**
AT	2 847	2 370	456	20	83	16	1
BE	62	26	31	5	42	50	8
BG	549	0	0	549	0	0	100
CY	3	3	0	0	87	9	4
CZ	81	58	5	17	72	7	22
DE	624	485	54	85	78	9	14
DK	631	358	271	2	57	43	0
EE	113	84	7	22	74	6	20
ES	5 475	2 257	360	2 858	41	7	52
FI	3 868	2 597	377	894	67	10	23
FR	32 467	14 814	3 941	13 712	46	12	42
GR	801	673	11	117	84	1	15
HR	761	759	0	1	100	0	0
HU	235	156	79	0	66	34	0
IE	184	142	42	0	77	23	0
IT	7 633	1 522	163	5 948	20	2	78
LT	73	41	9	23	56	12	32
LU	5	4	0	0	91	8	1
LV	629	93	47	489	15	7	78
MT	43	38	5	0	88	12	0
NL	500	169	164	167	34	33	33
PL	456	85	157	214	19	34	47
PT	595	318	107	170	53	18	29
RO (*)	61 107	53 508	526	7 074	88	1	12
SE	5 247	2 746	315	2 185	52	6	42

Source: European Environment Agency – April 2021

SI	754	245	15	494	32	2	66
SK	499	5	1	493	1	0	99

Notes: (*) areas reported by Romania largely overestimated.

Carbon stock and sequestration

Carbon sequestration and storage capacities of rocky and dune habitats are naturally low and, with few exceptions such as wooded dunes, provide only major contributions if the respective areas reach significant dimensions. Annual sequestration of these habitats is estimated to be about 5 Mio tons C per year or 18.4 Mio tons of CO_2. The storage capacity is estimated between 20 and 530 Mio tons of carbon equivalent to 73 to 1 945 tons of CO_2. Due to the nature of the habitats which are usually characterised by low vegetation and soil coverage the storage capacities are most likely more at the lower end of the estimated range. Only if covered by woody vegetation storage capacities per ha reach significant numbers even if annual sequestration rates are often low.

Table 8 – Carbon stock and sequestration of Annex I rocky and dune habitats

EU27 excluding Romania	Area (km^2)	Total Carbon Stock (Mt)		Potential carbon sequestration rate (Mt y^{-1})
		min	max	mean
Sea cliffs, beaches and islets	**5 728**	**0.00**	**42.97**	**0.43**
1210	172	0.00	1.29	0.01
1220	359	0.00	2.69	0.03
1230	645	0.00	4.84	0.05
1240	494	0.00	3.71	0.04
1250	260	0.00	1.95	0.02
1610	555	0.00	4.16	0.04
1620	3 217	0.00	24.13	0.24
1640	27	0.00	0.20	0.00
Coastal and inland dunes	**7 376**	**20.23**	**94.54**	**0.61**
2110	165	0.00	1.24	0.01
2120	354	0.00	2.66	0.03
2130	1 322	0.00	9.92	0.10
2140	312	2.34	4.68	0.07

EU27 excluding Romania	Area (km²)	Total Carbon Stock (Mt)		Potential carbon sequestration rate (Mt y-1)
		min	max	mean
2150	72	0.54	1.08	0.02
2160	154	0.00	1.16	0.01
2170	37	0.00	0.28	0.00
2180	2 069	15.52	46.55	0.16
2190	180	0.00	1.35	0.01
2210	44	0.00	0.33	0.00
2220	10	0.00	0.08	0.00
2230	79	0.00	0.59	0.01
2240	47	0.00	0.35	0.00
2250	132	0.00	0.99	0.01
2260	431	0.00	3.23	0.03
2270	408	0.00	6.12	0.43
2310	100	0.75	1.50	0.01
2320	90	0.68	1.35	0.01
2330	1 304	0.00	9.78	0.10
2340	13	0.00	0.10	0.00
91N0	54	0.41	1.22	0.01
Rocky habitats	**52 031**	**0.00**	**390.23**	**3.90**
8110	5 567	0.00	41.75	0.42
8120	2 747	0.00	20.60	0.21
8130	1 827	0.00	13.70	0.14
8140	315	0.00	2.36	0.02
8150	21	0.00	0.16	0.00
8160	86	0.00	0.65	0.01
8210	5 875	0.00	44.06	0.44
8220	6 721	0.00	50.41	0.50
8230	1 134	0.00	8.51	0.09
8310	25 694	0.00	192.71	1.93
8320	728	0.00	5.46	0.05
8340	1 316	0.00	9.87	0.10
TOTAL	**65 135**	**20.23**	**527.74**	**4.95**

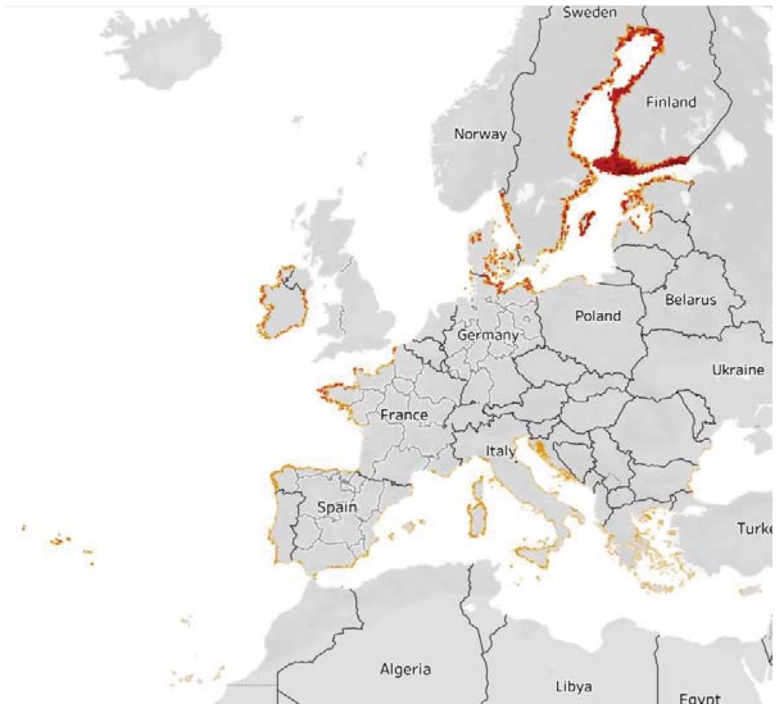
Source: European Environment Agency – April 2021

Note: areas reported by Romania note included.

Source: European Environment Agency – April 2021

Annex A

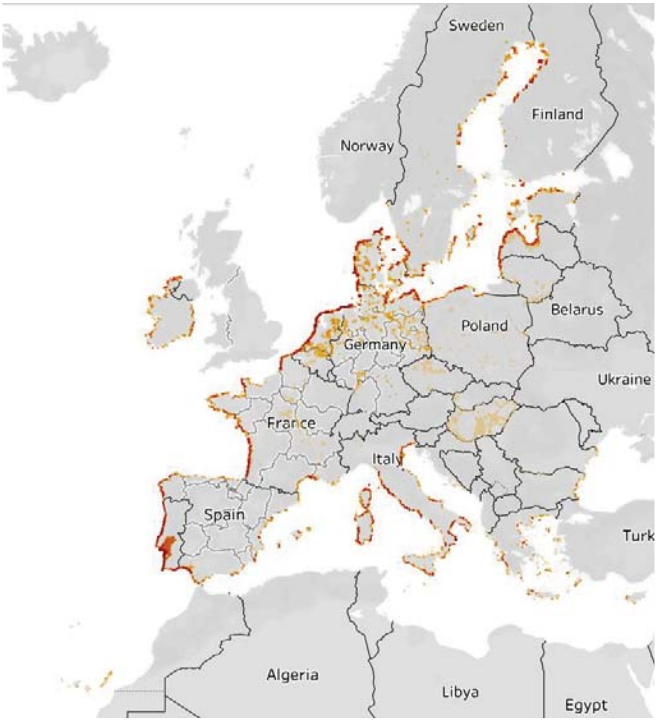
Map 2 – Distribution of Annex I sea cliffs, beaches, and islets (1210-1250, 1610, 1620, 1640)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell.

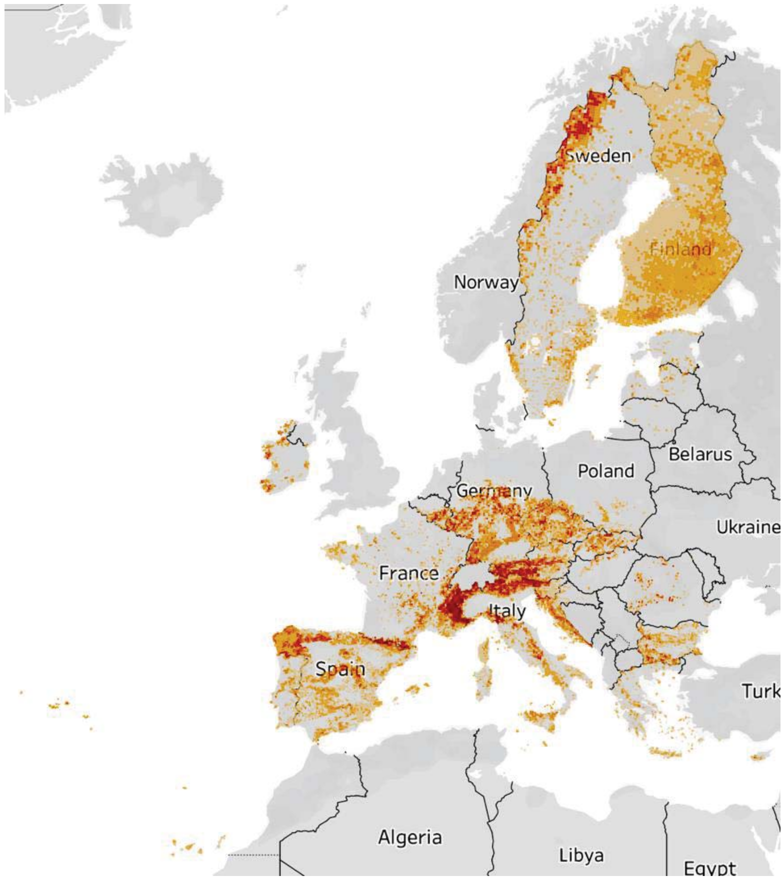
Map 3 – Distribution of Annex I coastal and inland dunes (2110-2190, 2210-2270, 2310-2340, 91N0)

Source: European Environment Agency – April 2021



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell.

Map 4 – Distribution of Annex I rocky habitats (8110-8160, 8210-8230, 8310-8340, except 8330)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell.

Source: European Environment Agency – April 2021

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PART 11/12

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

ANNEX VIII-f

Accompanying the

proposal for a Regulation of the European Parliament and of the Council

on nature restoration

{COM(2022) 304 final} - {SEC(2022) 256 final} - {SWD(2022) 168 final}

EN EN

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Annex VIII-f: RIVER, LAKE, ALLUVIAL AND RIPARIAN HABITATS

Introduction

This paper provides information derived from the Member States' reports and assessments under Article 17 of the Habitats Directive. It is a background information to help identify possible restoration targets for the 'legal binding instrument' under the EU Biodiversity Strategy to 2030.

The 'river, lake, alluvial and riparian habitats' group include, 32 Annex I habitat types (see Table 1): all rivers and lakes (codes 31xx and 32xx), and a selection of alluvial and riparian habitats.

Table 1 – River and lake Annex I habitat types selected

Rivers and lakes (20 types)		**Rivers and lakes (cont.)**	
3110	Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)	3280	Constantly flowing Mediterranean rivers with *Paspalo-Agrostidion* species and hanging curtains of *Salix* and *Populus alba*
3120	Oligotrophic waters containing very few minerals generally on sandy soils of the West Mediterranean, with *Isoetes* spp.	3290	Intermittently flowing Mediterranean rivers of the *Paspalo-Agrostidion*
3130	Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*	32A0	Tufa cascades of karstic rivers of the Dinaric Alps
3140	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.	**Alluvial meadows (4 types)**	
3150	Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* — type vegetation	6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels
3160	Natural dystrophic lakes and ponds	6440	Alluvial meadows of river valleys of the *Cnidion dubii*
3170	Mediterranean temporary ponds	6450	Northern boreal alluvial meadows
3180	Turloughs	6540	Sub-Mediterranean grasslands of the *Molinio-Hordeion secalini*
3190	Lakes of gypsum karst	**Alluvial/Riparian forests (8 types)**	
31A0	Transylvanian hot-spring lotus beds	9160	Sub-Atlantic and medio-European oak or oak-hornbeam forests of the *Carpinion betuli*
3210	Fennoscandian natural rivers	91E0	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)
3220	Alpine rivers and the herbaceous vegetation along their banks	91F0	Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *U. minor*, *Fraxinus excelsior* or *F. angustifolia*, along the great rivers (*Ulmenion minoris*)

Source: European Environment Agency – April 2021

3230	Alpine rivers and their ligneous vegetation with *Myricaria germanica*	92A0	Salix alba and *Populus alba* galleries
3240	Alpine rivers and their ligneous vegetation with *Salix elaeagnos*	92B0	Riparian formations on intermittent Mediterranean water courses with *Rhododendron ponticum*, *Salix* and others
3250	Constantly flowing Mediterranean rivers with *Glaucium flavum*	92C0	Platanus orientalis and Liquidambar orientalis woods (*Platanion orientalis*)
3260	Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	92D0	Southern riparian galleries and thickets (*Nerio-Tamaricetea* and Securinegion tinctoriae)
3270	Rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation		

'River, lake, alluvial and riparian habitats' coverage in the EU

The 32 habitat types selected cover close to **96 480 km^2** (**2.5 %** of the EU terrestrial area[1]); this excludes areas reported by Romania, which are known to be largely overestimated[2].

The data available from Corine Land Cover[3] and from the Ecosystems Map of Europe[4] do not allow a straightforward comparison between the total area of 'rivers and lakes' in the EU and the area covered by Annex I 'river, lake, alluvial and riparian habitats'. This is mainly due to the nomenclatures used and the spatial resolution of the datasets. A comparison between these data sources – excluding alluvial meadows and alluvial/riparian forests – is given in Table 2 below.

Table 2 – River and lake areas (km^2) from different sources (EU27)

Corine Land Cover 2018 (level 3)

Inland waters	**106 873**
511 – Water courses	10 162
512 – Water bodies	96 711

Ecosystems map (level 3)

C – Inland surface waters	**110 687**
C1 – Surface standing waters	98 278
C2 – Surface running waters	10 405
C3 – Littoral zone of inland surface waterbodies	2 004

The areas of 'river, lake, alluvial and riparian habitats', have a good representation in most EU countries (except Malta) (see Map 1). The Member States with the highest proportion of those habitats are Finland (10 %), Croatia (6 %), Lithuania (3 %), Sweden (3 %) and

[1] Area of habitats calculated from the area reported by Member States as 'best estimate' or 'average of minimum/maximum'

[2] The average total area of river, lakes and alluvial habitats reported by Romania is 91 903 km^2

[3] https://www.eea.europa.eu/data-and-maps/dashboards/land-cover-and-change-statistics

[4] https://www.eea.europa.eu/themes/biodiversity/mapping-europes-ecosystems

Estonia (3 %); over half of the Member States have less than 2 % of their territory covered by Annex I 'river, lake, alluvial and riparian habitats'.

One Member State reported a very small area: Malta (0.4 km^2).

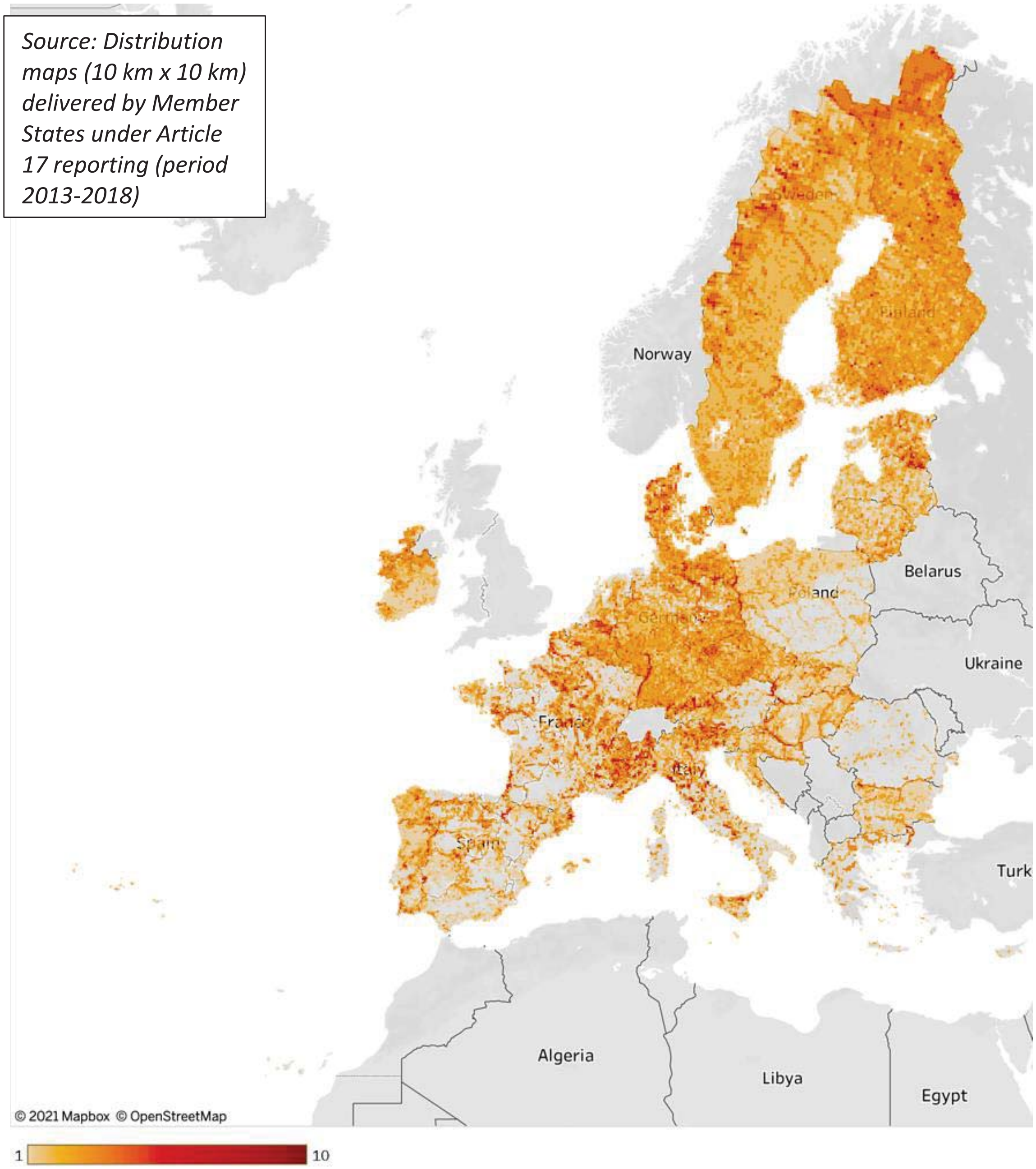
Table 3 gives the areas and proportion of 'river, lake, alluvial and riparian habitats' for each Member State, including coverage by Natura 2000. Maps illustrating the distribution of those Annex I habitats in the EU are available in Annex A.

From the 96 480 km^2 of 'river, lake, alluvial and riparian habitats' (excluding Romania), **40 %** is estimated to be inside the Natura 2000 network (about **38 592 km^2**); this may be an underestimation since reports from Member States were not comprehensive on this regard. The coverage by Natura 2000 varies according to the sub-group, **from 66 %** for 'rivers' **to 36 %** for 'lakes'. The proportion of habitats per sub-group of 'river, lake, alluvial and riparian habitats' and their coverage is detailed in Table 4.

Coverage by Natura 2000 also greatly varies according to the Member State: **from over 96 %** (Bulgaria) **to less than 30 %** (Austria, Cyprus and France) (Table 3).

However, a few Member States reported over 75 % of 'river, lake, alluvial and riparian habitats' area inside Natura 2000 (Estonia, Hungary, Netherlands, and Sweden).

Map 1 – Distribution of the 32 Annex I 'river, lake, alluvial and riparian habitats' in the EU



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell.

Source: European Environment Agency – April 2021

Table 3 – Area and proportion of 'river, lake, alluvial and riparian habitats' per Member State

	Member State area (km^2)	In the Member State		Proportion of the river & lake area (%)	Inside Natura 2000	
		River & lake area (km^2)	River & lake area (%)		River & lake area	% River & lake area
Austria	83 944	1 279.8	1.5	1.33	305.4	23.9
Belgium	30 683	741.1	2.4	0.77	316.2	42.7
Bulgaria	110 995	532.9	0.5	0.55	514.1	96.5
Croatia	55 590	3 260.5	5.9	3.38	1 808.2	55.5
Cyprus	9 249	28.1	0.3	0.03	16.7	59.5
Czechia	78 874	1 038.4	1.3	1.08	310.1	29.9
Denmark	44 162	980.7	2.2	1.02	317.2	32.3
Estonia	45 382	1 155.9	2.5	1.20	1 039.0	89.9
Finland	338 004	35 197.9	10.4	36.48	7 598.1	21.6
France	551 881	12 027.5	2.2	12.47	2 936.9	24.4
Germany	362 177	4 424.4	1.2	4.59	2 658.4	60.1
Greece	132 014	1 342.3	1.0	1.39	423.1	31.5
Hungary	93 012	1 325.5	1.4	1.37	1 095.3	82.6
Ireland	70 699	1 622.6	2.3	1.68	1 005.0	61.9
Italy	301 321	4 116.9	1.4	4.27	1 894.1	46.0
Latvia	64 590	1 238.1	1.9	1.28	599.8	48.4
Lithuania	65 289	1 855.4	2.8	1.92	1 292.1	69.6
Luxembourg	2 595	33.1	1.3	0.03	16.6	50.2
Malta	316	0.4	0.1	0.00	0.2	70.0
Netherlands	39 898	252.0	0.6	0.26	189.1	75.0
Poland	312 683	6 738.2	2.2	6.98	2 480.4	36.8
Portugal	92 378	74.4	0.1	0.08	43.5	58.4
Romania (*)	*238 404*	91 903.0	38.5	95.26	4 418.3	4.8
Slovakia	49 026	184.3	0.4	0.19	65.6	35.6
Slovenia	20 274	571.2	2.8	0.59	376.2	65.9
Spain	506 222	3 724.7	0.7	3.86	1 805.6	48.5
Sweden	450 110	12 733.4	2.8	13.20	9 484.6	74.5
Total	4 149 772	188 382.8	4.5		43 009.9	22.8
Total (without Romania)	**3 911 772**	**96 479.8**	**2.5**		**38 591.6**	**40.0**

Source: European Environment Agency – April 2021

Notes: Member States with more than 2.5 % (the EU average) of their terrestrial area covered by wetlands are highlighted; (*) areas reported by Romania are overestimated. 'River & lake' means 'river, lake, alluvial and riparian habitats'.

Table 4 – Area and proportion of 'river, lake, alluvial and riparian habitats' per sub-group

		Inside Natura 2000	
EU27 excluding Romania	**Area (km^2)**	**River & lake area (km^2)**	**% river & lake area**
Lakes	**59 121**	**21 286**	**36**
3110	17 509	3 949	23
3120	6	3	56
3130	8 302	5 069	61
3140	2 975	4 682	157(*)
3150	11 180	3 859	35
3160	18 813	3 519	19
3170	234	129	55
3180	100	76	76
3190	2	1	35
Rivers	**8 191**	**5 386**	**66**
3210	1 559	2 135	137(*)
3220	1 058	468	44
3230	65	24	37
3240	379	171	45
3250	250	162	65
3260	4 194	1 956	47
3270	419	293	70
3280	206	141	69
3290	61	34	56
32A0	1	2	232
Alluvial meadows	**5 747**	**2 128**	**37**
6430	4 452	1 144	26
6440	663	530	80
6450	559	417	75
6540	73	38	51
Alluvial/riparian forests	**23 421**	**9 792**	**42**
9160	7 100	1 814	26
91E0	8 358	4 167	50
91F0	3 646	2 093	57
92A0	2 219	985	44
92B0	5	8	162(*)
92C0	601	155	26
92D0	1 467	560	38
9370	25	11	43
TOTAL	**88 289**	**38 592**	**44**

Note: habitat 31A0 only occurs in Romania (#) does not include the wrong value (5 800 km2) reported by Croatia; (*) percentage over 100 % due to inconsistencies in data reported, namely in surface areas of 3140 and 3210 in Sweden, 32A0 in Croatia, and 92B0 in Portugal

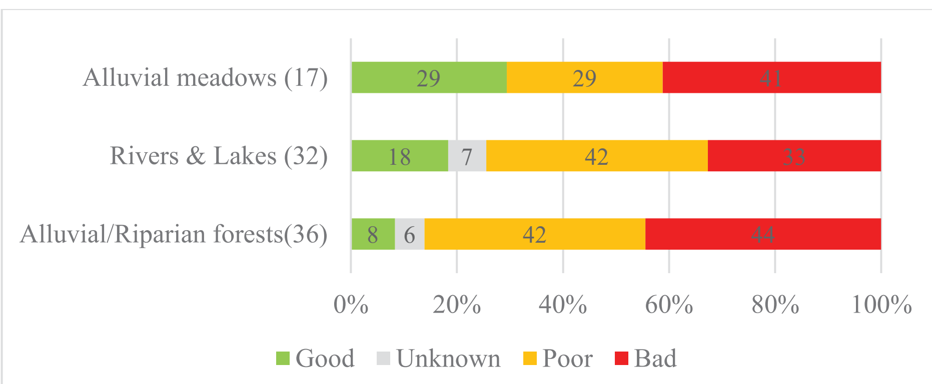
Conservation status and trends

More than three-quarters of the assessments (**76 %**) of the 32 'river, lake, alluvial and riparian habitats' at the EU level have an **unfavourable** conservation status (40 % poor and 36 % bad). Only **17 %** have a **good** conservation status. There are some differences between the different habitat groups (Figure 1): 'alluvial meadows' has the highest proportion of good status (29 %) and the 'alluvial/riparian forest' habitats the worst status (86 % unfavourable).

Among the habitat assessments that do not have a good status, over a third have a **deteriorating** trend (**38 %**) while only **6 %** have an improving trend. An additional **34 %** maintain their unfavourable status; the conservation status trend is unknow for **23 %** of the assessments. The groups with the worst conservation status trends are **'alluvial meadows'** and **'alluvial/riparian forests'** (**42 % deteriorating**); however, **'alluvial meadows'** also have the higher proportion of **improving** trends (**17** %) (Figure 2).

Details on conservation status and conservation status trends for each Member State are given in Table 5.

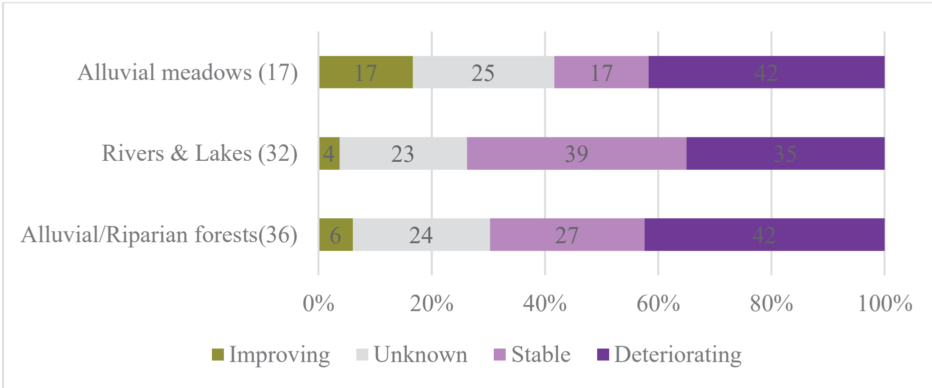
Figure 1 – Conservation status of 'river, lake, alluvial and riparian habitats' at the EU level (in percentage)



Note: Number of assessments per group shown in brackets.

Figure 2 – Conservation status trends of 'river, lake, alluvial and riparian habitats' at the EU level (in percentage)

Source: European Environment Agency – April 2021



Note: Number of assessments per group shown in brackets.

Table 5 – Conservation status and trends of 'river, lake, alluvial and riparian habitats' in the Member States (in percentage)

Member State	FV	U1-	U1+	U1=	U1x	U2-	U2+	U2=	U2x	XX
AT (26)	4				31	8		12	38	8
BE (21)			5	5	14	14	14	29	14	5
BG (32)	6	3	22	38	6	3			19	3
CY (7)	14			14	14	14		43		
CZ (22)		18		36	9	23		14		
DE (42)	19	17	12	5		19	10	10	10	
DK (20)					25	20			55	
EE (11)	55	18	9	9	9					
ES (46)	4	13		22	24	9		4	2	22
FI (19)	42	5	5	26		5		16		
FR (55)	7	16		20	9	29		13	4	2
GR (16)	50		13	31				6		
HR (31)	32			23	13	6		3	3	19
HU (9)		22		22		56				
IE (10)	10	20		30		30		10		
IT (53)		13	4	9	6	43	2	8	8	8
LT (12)	25			8	42				25	
LU (7)		14		14		14	29	29		
LV (12)	8			25	33	17				17
MT (4)						25		75		
NL (11)	9		9	18	9	36	18			
PL (20)	10			30	5	20	5	25		5
PT (30)	30	33	3	13		17				3
RO (51)	73	8		16	2	2				
SE (34)	29	24		18	3	3			24	
SI (21)	19	10	5			38		19	10	
SK (22)	18	5		41	18	5			5	9

Source: European Environment Agency – April 2021

Notes: FV = good, U1 = poor, U2 = bad, XX = unknown conservation status '-' = deteriorating, '+' = improving, '=' = stable, 'x' = unknown conservation status trend; number of assessments per Member State shown in brackets.

Source: European Environment Agency – April 2021

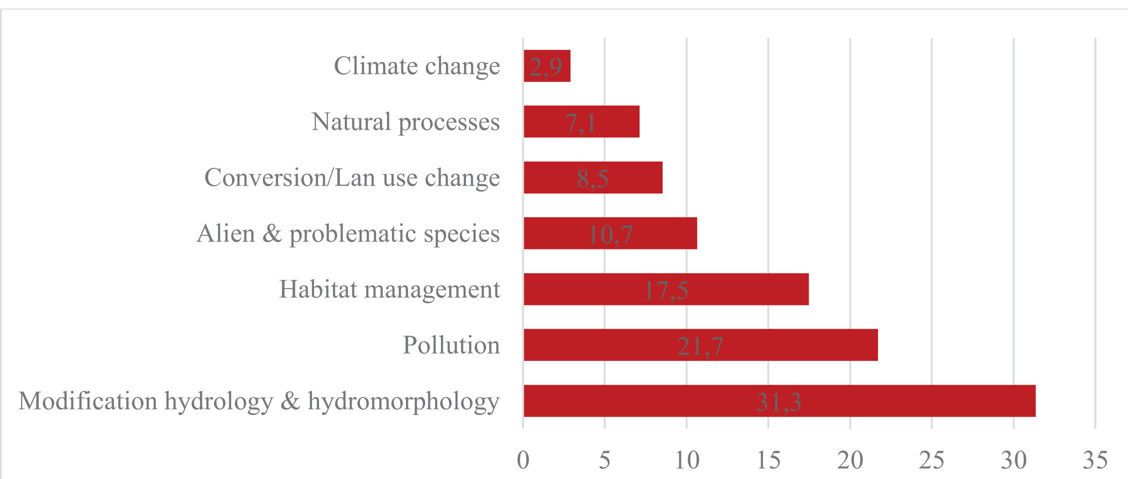
Pressures

'River, lake, alluvial and riparian habitats' are subject to a wide diversity of pressures resulting in their degradation and extirpation. According to Member States reports under Article 17 of the Habitats Directive, the top three groups of pressures (in percentage of the total) are:

- **Modification of hydrology and hydro-morphology** with over **33 %** of all pressures; this includes e.g., drainage, water abstraction, and dams and reservoirs
- **Pollution** from different origins close to **22 %**; from these, over two-thirds (67 %) is originated from agriculture activities, about 18 % from mixed sources and 12 % from residential, industrial, and recreational activities
- **Habitat management**, with over **18 %**; these include inadequate agricultural practices like under or grazing and mowing (32 %), forestry like logging and removal of dead and old trees (44 %), mineral extraction (14 %) and freshwater fish and shellfish activities (9 %).

Equally important is the group '**invasive and problematic species**' with close to **11 %**, and '**conversion and land use change**' with near **9 %** of all reported pressures; the later includes development of infrastructures (over 50 %) and conversion of habitats to other land uses (about 43 %).

Figure 3 – Pressures reported for 'river, lake, alluvial and riparian habitats' (in percentage)



Note: based on pressures reported as 'high-ranking'.

Condition of habitats

Member States reported on the condition of habitat types under Article 17 of the Habitats Directive. This data can be used to estimate the area of 'river, lake, alluvial and riparian habitats' assessed as degraded (condition not-good) therefore, requiring restoration.

The area of 'river, lake, alluvial and riparian habitats' that would need to be restored, i.e., improved condition, is **at least 21 560 km^2**, representing **22 %** of the total area reported for this group of habitats (the values exclude Romania). However, the condition of habitats reported as 'unknown' (or not reported) is over 18 000 km^2 (21 % of the total area). This means that the area requiring restoration is bigger than 21 560 km^2; for example, assuming that half of the 'unknown' area is in a not-good condition, the area to be restored would be over 32 560 km^2 or 43 500 km^2 if all the 'unknown' is assumed to be in a 'not-good' condition (23 % of the total area). Table 6 gives information for each of the 32 'river, lake, alluvial and riparian habitats' (excluding Romania) and Table 7 the condition areas and percentage for each of the Member States.

In addition to the habitat condition, Member States also reported on the 'favourable reference areas'[5]. Comparing this area with the actual habitat area allows to estimate how much area of the habitat would need to be re-created to achieve a good distribution and area of the habitat. Based on this data, it is estimated that a **strict minimum** of **894 km^2** would need to be **re-created** to achieve a ‘favourable area’:

- 282 km^2 of river and lake habitats
- 27 km^2 of alluvial meadows
- 585 km^2 of alluvial and riparian habitats

However, these values are much higher since several Member States did not provide enough information in their reports to allow a more realistic estimation.

[5] The surface area in a given biogeographical region considered the minimum necessary to ensure the long-term viability of the habitat type; this should include necessary areas for restoration or development for those habitat types for which the present coverage is not sufficient to ensure long-term viability

Table 6 – Condition of 'river, lake, alluvial and riparian habitats' per Annex I habitat type

		Condition (area in km2)			Condition (in percentage)		
	Habitat area	Good	Not-good	Unknown	Good	Not-good	Unknown
Total	**96 480**	**52 971**	**21 557**	**21 952**	**55**	**22**	**23**
Lakes	**59 121**	**36 760**	**9 953**	**12 408**	**62**	**17**	**21**
3110	17 509	12 649	1 430	3 430	72	8	20
3120	6			6			100
3130	8 302	4 160	1 091	3 050	50	13	37
3140	2 975	1 258	952	766	42	32	26
3150	11 180	5 106	4 097	1 978	46	37	18
3160	18 813	13 462	2 314	3 037	72	12	16
3170	234	77	65	93	33	28	40
3180	100	49	3	48	49	3	48
3190	2	1	1	1	33	37	30
Rivers	**8 191**	**3 158**	**1 564**	**3 469**	**39**	**19**	**42**
3210	1 559	1 032	197	330	66	13	21
3220	1 058	640	106	311	61	10	29
3230	65	32	31	2	49	48	2
3240	379	99	64	216	26	17	57
3250	250	36	52	162	14	21	65
3260	4 194	1 013	882	2 299	24	21	55
3270	419	146	159	113	35	38	27
3280	206	155	64	-14	75	31	-7(*)
3290	61	3	8	50	5	13	81
32A0	1	1			54		46
Alluvial meadows	**5 747**	**2 121**	**1 362**	**2 263**	**37**	**24**	**39**
6430	4 452	1 709	851	1 892	38	19	42
6440	663	212	296	155	32	45	23
6450	559	195	215	149	35	38	27
6540	73	5		68	7		93
Alluvial/riparian forests	**23 421**	**10 932**	**8 677**	**3 812**	**47**	**37**	**16**
9160	7 100	2 654	3 465	981	37	49	14
91E0	8 358	4 288	3 617	454	51	43	5
91F0	3 646	2 263	1 316	68	62	36	2
92A0	2 219	785	175	1 259	35	8	57
92B0	5			4	3	4	93
92C0	601	529	15	57	88	2	10
92D0	1 467	404	89	973	28	6	66
9370	25	10		15	40	1	59

Notes: Areas reported by Romania excluded from the table (therefore, habitat 31A0 not included in the table); (*) issue with data for habitat 3280 in the Mediterranean region of France

Source: European Environment Agency – April 2021

Table 7 – Condition of Annex I 'river, lake, alluvial and riparian habitats' per Member State

	Habitat's area (km²)				Percentage		
Member State	**Total**	**Good**	**Not-good**	**Unknown**	**Good**	**Not-good**	**Unknown**
AT	1 279.8	107.9	107.5	1 064.4	8	8	83
BE	741.1	55.0	231.2	454.9	7	31	61
BG	532.9	185.8	221.7	125.4	35	42	24
CY	28.1	11.5	16.6	0.0	41	59	0
CZ	1 038.4	756.9	169.6	111.9	73	16	11
DE	4 424.4	2 645.0	1 176.6	602.8	60	27	14
DK	980.7	118.6	550.3	311.8	12	56	32
EE	1 155.9	501.4	52.8	601.7	43	5	52
ES	3 724.7	697.2	553.2	2 474.3	19	15	66
FI	35 197.9	25 277.4	3 659.7	6 260.8	72	10	18
FR	12 027.5	5 926.1	6 677.5	-576.1	49	56	-5(#)
GR	1 342.3	1 089.7	35.9	216.6	81	3	16
HR	3 260.5	2 809.3	202.5	248.8	86	6	8
HU	1 325.5	477.0	607.7	240.8	36	46	18
IE	1 622.6	217.4	928.2	477.0	13	57	29
IT	4 116.9	1 393.9	291.0	2 432.0	34	7	59
LT	1 855.4	82.7	82.7	1 690.0	4	4	91
LU	33.1	29.5	2.0	1.6	89	6	5
LV	1 238.1	565.8	200.1	472.3	46	16	38
MT	0.4	0.2	0.2	0.0	58	44	0
NL	252.0	118.0	95.8	38.2	47	38	15
PL	6 738.2	2 914.9	3 819.6	3.7	43	57	0
PT	74.4	30.5	36.9	7.0	41	50	9
RO (*)	91 903.0	70 785.5	3 026.5	18 091.0	77	3	20
SE	12 733.4	6 615.2	1 649.5	4 468.7	52	13	35
SI	571.2	328.4	176.9	66.0	57	31	12
SK	184.3	21.6	17.4	145.4	12	9	79

Notes: (*) areas reported by Romania largely overestimated; (#) issue with data for several habitats

Carbon stock and sequestration

The habitats associated to rivers and lakes are a combination of forests, semi-natural grasslands and freshwater habitats. As carbon sequestration rates and stocks in freshwater habitats are low, forests and grasslands contribute most to the carbon uptake and storage of these habitats. Uptake and down-stream transport of dissolved organic carbon (DOC) in freshwater bodies is not considered in this assessment.

Annual carbon uptake is estimated to be around 12 Mio tons of C equivalent to 44 Mio tons of CO2 accumulating between 0,2 and 1,0 Gt C equivalent to 0,7 and 3,6 Gt of CO2. Contribution of forest habitats to annual sequestration is more than 50% despite covering less than 25% of the area. Also more than 45% of the carbon is stored in these habitats. Carbon storage in natural and semi-natural grasslands is similar to forests despite sequestration rates are low. Overall contribution to sequestration and storage is relatively low as they only cover less than 6% of the area.

Table 8 – Carbon stock and sequestration of Annex I 'river, lake, alluvial and riparian habitats'

	River, lake, alluvial, riparian area (km^2)	Total Carbon Stock (Mt)		Potential carbon sequestration rate (Mt y^{-1})
	EU-27	min	max	mean
Rivers and lakes	**67 311.75**	**0.00**	**504.84**	**5.05**
3110	17 508.85	0.00	131.32	1.31
3120	5.93	0.00	0.04	0.00
3130	8 301.72	0.00	62.26	0.62
3140	2 975.41	0.00	22.32	0.22
3150	11 180.47	0.00	83.85	0.84
3160	18 812.96	0.00	141.10	1.41
3170	233.99	0.00	1.75	0.02
3180	100.19	0.00	0.75	0.01
3190	1.68	0.00	0.01	0.00
3210	1 559.00	0.00	11.69	0.12
3220	1 057.51	0.00	7.93	0.08
3230	64.61	0.00	0.48	0.00
3240	379.41	0.00	2.85	0.03
3250	249.59	0.00	1.87	0.02
3260	4 194.35	0.00	31.46	0.31
3270	418.63	0.00	3.14	0.03
3280	205.60	0.00	1.54	0.02
3290	60.93	0.00	0.46	0.00
32A0	0.93	0.00	0.01	0.00
Alluvial meadows	**5 746.53**	**43.10**	**129.30**	**0.76**
6430	4 451.99	33.39	100.17	0.67
6440	662.58	4.97	14.91	0.05
6450	558.95	4.19	12.58	0.04
6540	73.00	0.55	1.64	0.01
Alluvial and riparian forests	**23 421.48**	**175.47**	**404.57**	**6.04**
9160	7 099.91	53.25	159.75	2.66
91E0	8 358.46	62.69	125.38	2.51
91F0	3 646.11	27.35	54.69	0.55
92A0	2 219.16	16.64	33.29	0.17
92B0	4.81	0.04	0.07	0.00
92C0	601.25	4.51	9.02	0.05
92D0	1 466.65	11.00	22.00	0.11
9370	25.13	0.00	0.38	0.00
TOTAL	**96 479.75**	**218.57**	**1 038.71**	**11.85**

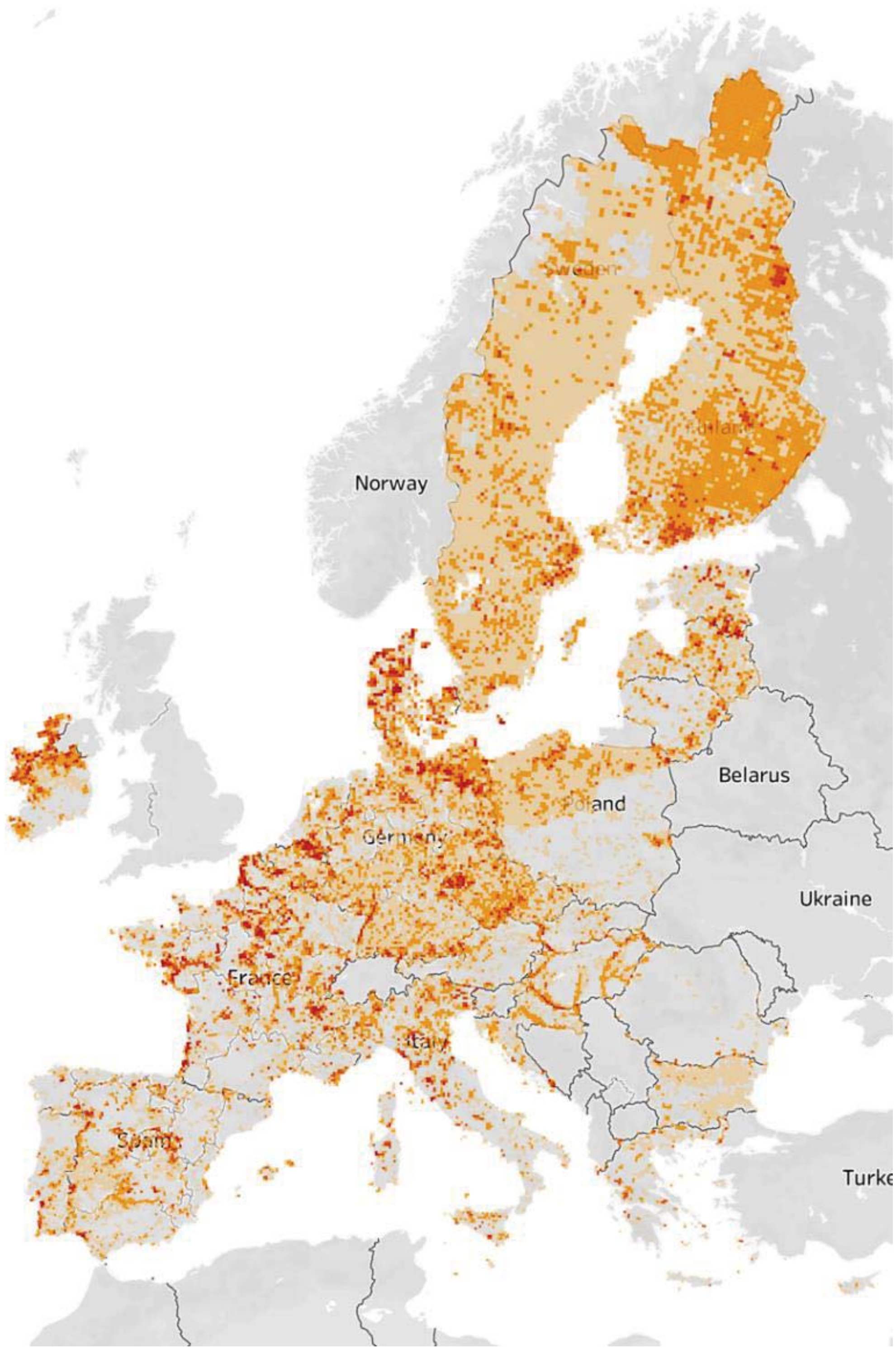
Source: European Environment Agency – April 2021

Note: areas reported by Romania note included

Source: European Environment Agency – April 2021

Annex A

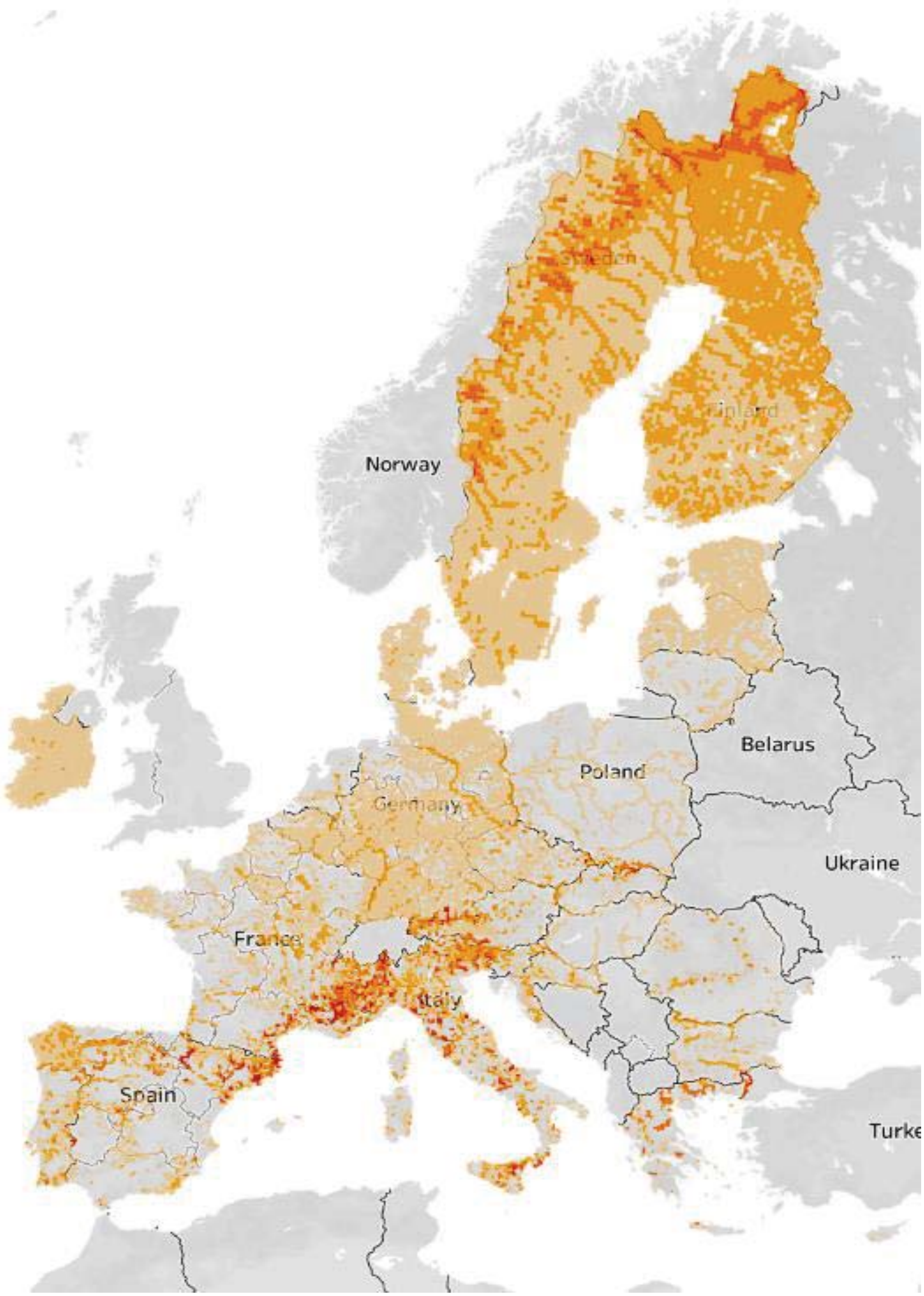
Map 2 – Distribution of Annex I lake habitats (3110, 3120, 3130, 3140, 3150, 3160, 3170, 3180, 3190)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell. Macaronesian islands not shown in the map.

Source: European Environment Agency – April 2021

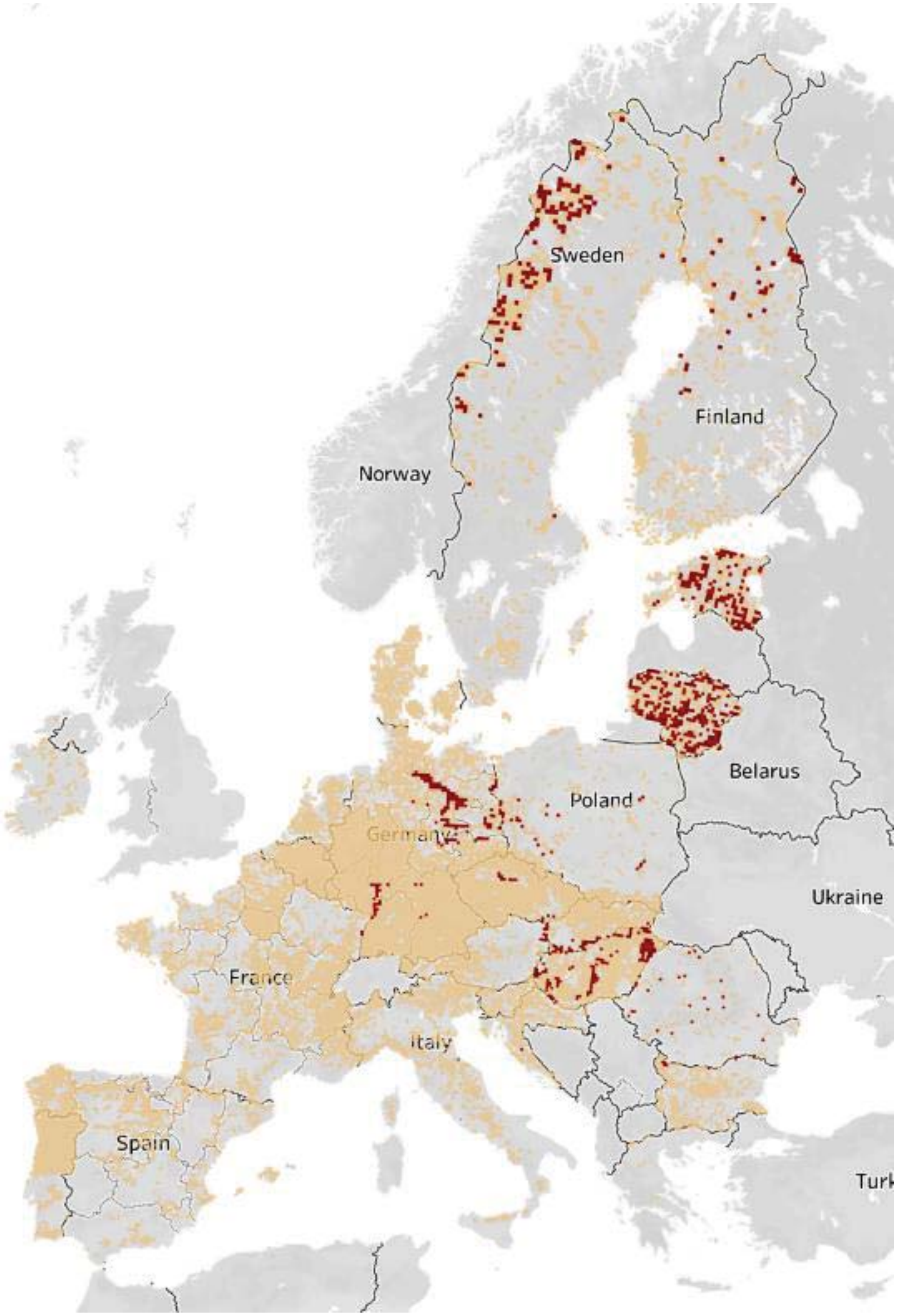
Map 3 – Distribution of Annex I river habitats (3210, 3220, 3230, 3240, 3250, 3260, 3270, 3280, 3290, 32A0)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell. Macaronesian islands not shown in the map.

Source: European Environment Agency – April 2021

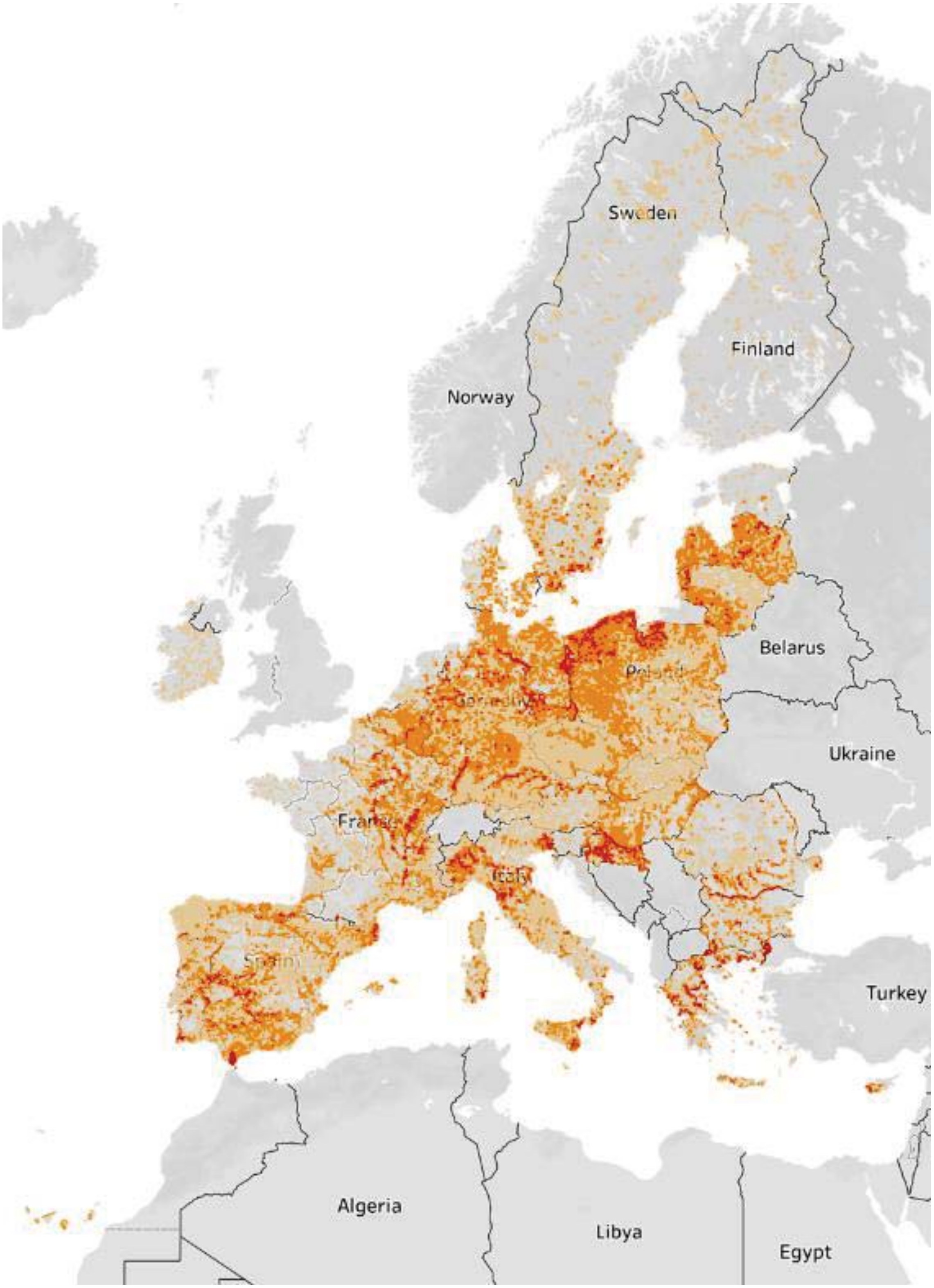
Map 4 – Distribution of Annex I alluvial meadow habitats (6430, 6440, 6450, 6540)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell. Macaronesian islands not shown in the map.

Source: European Environment Agency – April 2021

Map 5 – Distribution of Annex I alluvial and riparian forest habitats (9160, 91E0, 91F0, 92A0, 92B0, 92C0, 92D0, 9370)



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell. Azores islands not shown in the map.

Source: European Environment Agency – April 2021

EUROPEAN
COMMISSION

Brussels, 22.6.2022
SWD(2022) 167 final

PART 12/12

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

ANNEX VIII-g

Accompanying the

proposal for a Regulation of the European Parliament and of the Council

on nature restoration

{COM(2022) 304 final} - {SEC(2022) 256 final} - {SWD(2022) 168 final}

EN EN

Table of Contents

Annex VIII-g: MARINE

Introduction

This paper provides information derived from the Member States' reports and assessments under Article 17 of the Habitats Directive. It is a background information to help identify possible restoration targets for the 'legal binding instrument' under the EU Biodiversity Strategy to 2030.

The 'marine' group includes six habitat types listed in Annex I of the Habitats Directive (see Table 1). Three other habitats, normally considered marine, are included in the 'wetlands' group[1].

Table 1 – Marine Annex I habitat types selected for this analysis

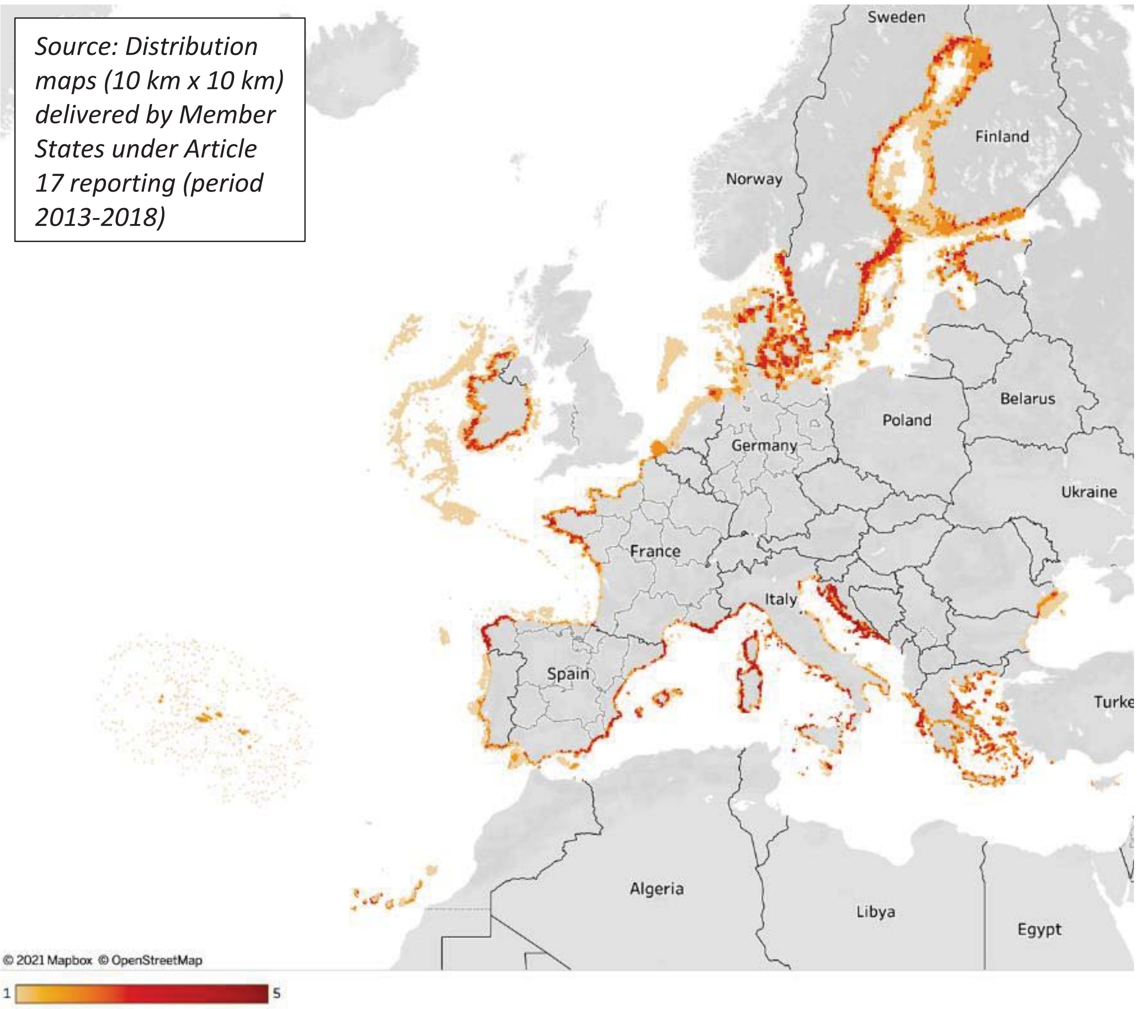
Marine habitats (6 types)	
1110	Sandbanks which are slightly covered by sea water all the time
1120	Posidonia beds (Posidonion oceanicae)
1160	Large shallow inlets and bays
1170	Reefs
1180	Submarine structures made by leaking gases
8330	Submerged or partially submerged sea caves

[1] 1130 – Estuaries, 1140 – Mudflats and sandflats not covered by sea water at low tide, 1150 – Coastal lagoons

Marine Annex I coverage in the EU

The six habitat types selected cover over[2] **240 030 km²** (see Map 1); this excludes areas reported by Romania, which are known to be largely overestimated[3].

Map 1 – Distribution of the 6 Annex I marine habitats in the EU



Note: the shades of brown indicate the number of habitat types per 10 km x 10 km grid cell.

Table 2 gives the areas of marine habitats for each Member State, including coverage by Natura 2000 network. Maps illustrating the distribution of each marine habitat in the EU are available in Annex A.

The habitat type with the largest area is 1170 – reefs (55 % of the total marine habitats), followed by 1110 – sandbanks (26 %) and 1160 – large shallow inlets and bays (16 %).

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[2] Area of habitats calculated from the area reported by Member States as 'best estimate' or 'average of minimum/maximum'.

[3] The average total area of marine habitats reported by Romania is 9 270 km^2.

From the 240 030 km^2 of marine habitats (excluding Romania), only **30%** is estimated to be inside the Natura 2000 network (about **71 255 km^2**); this may be an underestimation since reports from Member States were not comprehensive in this regard (Table 2).

Table 2 – Area and proportion of marine Annex I habitats per Member State

	In the Member State		Inside Natura 2000	
	Marine habitats area (km^2)	**Proportion of the marine habitats (%)**	**Marine area (km^2)**	**% marine area**
Belgium	4 617.0	1.85	1 606.0	79.4
Bulgaria	116.6	0.05	42.7	76.3
Croatia (#)	798.4	0.32	1 037.2	129.9
Cyprus	398.6	0.16	204.4	51.3
Denmark	17 530.8	7.03	8 284.9	47.3
Estonia	3 077.0	1.23	659.0	21.4
Finland	3 495.0	1.40	839.0	24.0
France	41 067.8	16.47	11 488.5	28.0
Germany	15 814.9	6.34	10 798.8	68.3
Greece	10 850.0	4.35	1 119.0	10.3
Ireland	27 187.0	10.91	4 600.0	16.9
Italy	3 980.8	1.60	2 206.1	55.4
Latvia	1 037.8	0.42	670.6	64.6
Lithuania	461.0	0.18	187.9	40.8
Malta	297.6	0.12	261.7	87.9
Netherlands	12 907.0	5.18	9 338.0	72.3
Poland	864.9	0.35	864.9	100.0
Portugal	65 290.0	26.19	381.4	0.6
Romania (*)	9 269.5	3.72	5 169.5	55.8
Slovenia	0.1	0.00	0.1	45.8
Spain	12 648.7	5.07	10 638.8	84.1
Sweden	17 590.0	7.06	6 026.0	34.3
Total	249 300.6		76 424.4	30.7
Total (without Romania)	**240 030.1**		**71 254.9**	**29.7**

Notes: (*) areas reported by Romania likely to be overestimated; (#) Croatia reported a bigger area in the network than the total area of the habitat in the country.

Coverage by Natura 2000 sites greatly varies according to the Member State: **from 100 %** (Croatia, Poland) **to less than 1 %** (Portugal[4]). The degree of coverage by the network also varies from habitat to habitat: from only 6% for marine caves to over 50% for sandbanks and *Posidonia* beds (Table 3).

Table 3 – Area and proportion of marine habitats per sub-group

		Inside Natura 2000	
EU27 excluding Romania	**Area of marine habitat (km²)**	**marine area (km²)**	**% marine area**
1110	61 038	31 435	52
1120	8 015	3 997	50
1160	36 220	14 988	41
1170	126 488	20 173	16
1180	408	187	46
8330	7 863	475	6
TOTAL	**240 030**	**71 255**	**30**

Condition of habitats

Member States reported on the condition of habitat types under Article 17 of the Habitats Directive. This data can be used to estimate the area of marine habitats assessed as degraded (condition not-good) therefore, requiring restoration.

The area of Annex I marine habitats that would need to be restored, i.e., improved condition, is **at least 34 828 km^2**, representing **15 %** of the total area of marine habitats reported (the values exclude Romania). However, the condition of habitats reported as 'unknown' (or not reported) is about 168 390 km^2 (70 % of the total habitat area). This means that the area requiring restoration is much bigger than 34 828 km^2; for example, assuming that half of the 'unknown' area is in a not-good condition, the area to be restored would be over 119 000 km^2 or 203 200 km^2 if all the 'unknown' is assumed to be in a 'not-good' condition (70 % of the total marine habitats area). Table 4 gives information for each of the six marine habitats (excluding Romania) and Table 5 the condition areas and percentage for each of the Member States.

In addition to the habitat condition, Member States also reported on the 'favourable reference areas'[5]. Comparing this area with the actual habitat area allows to estimate how much area of the habitat would need to be re-created to achieve a good distribution and area of the habitat. Based on this data, it is estimated that a **strict minimum** of **1 620 km^2** would need to be **re-created** to achieve a ‘favourable area’.

[4] This very small percentage may be due to issues in the reported data.
[5] The surface area in a given marine region considered the minimum necessary to ensure the long-term viability of the habitat type; this should include necessary areas for restoration or development for those habitat types for which the present coverage is not sufficient to ensure long-term viability.

However, these values are much higher since several Member States did not provide enough information in their reports to allow a more realistic estimation.

Table 4 – Condition of Annex I marine habitats

		Condition (area in km2)			Condition (in percentage)		
	Habitat area	**Good**	**Not-good**	**Unknown**	**Good**	**Not-good**	**Unknown**
Marine habitat	**240 031.1**	**36 813.1**	**34 827.6**	**168 390.4**	**15**	**15**	**70**
1110	61 038.0	11 891.7	14 204.7	34 941.6	13	36	52
1120	8 014.5	3 100.0	461.5	4 452.9	34	8	57
1160	36 220.2	2 488.0	13 297.3	20 434.9	13	25	62
1170	126 487.6	19 271.3	6 861.0	100 355.2	82	7	11
1180	407.5	25.0	0.0	382.5	76	16	8
8330	7 863.2	37.0	3.0	7 823.2	61	35	4

Note: Areas reported by Romania excluded from the table.

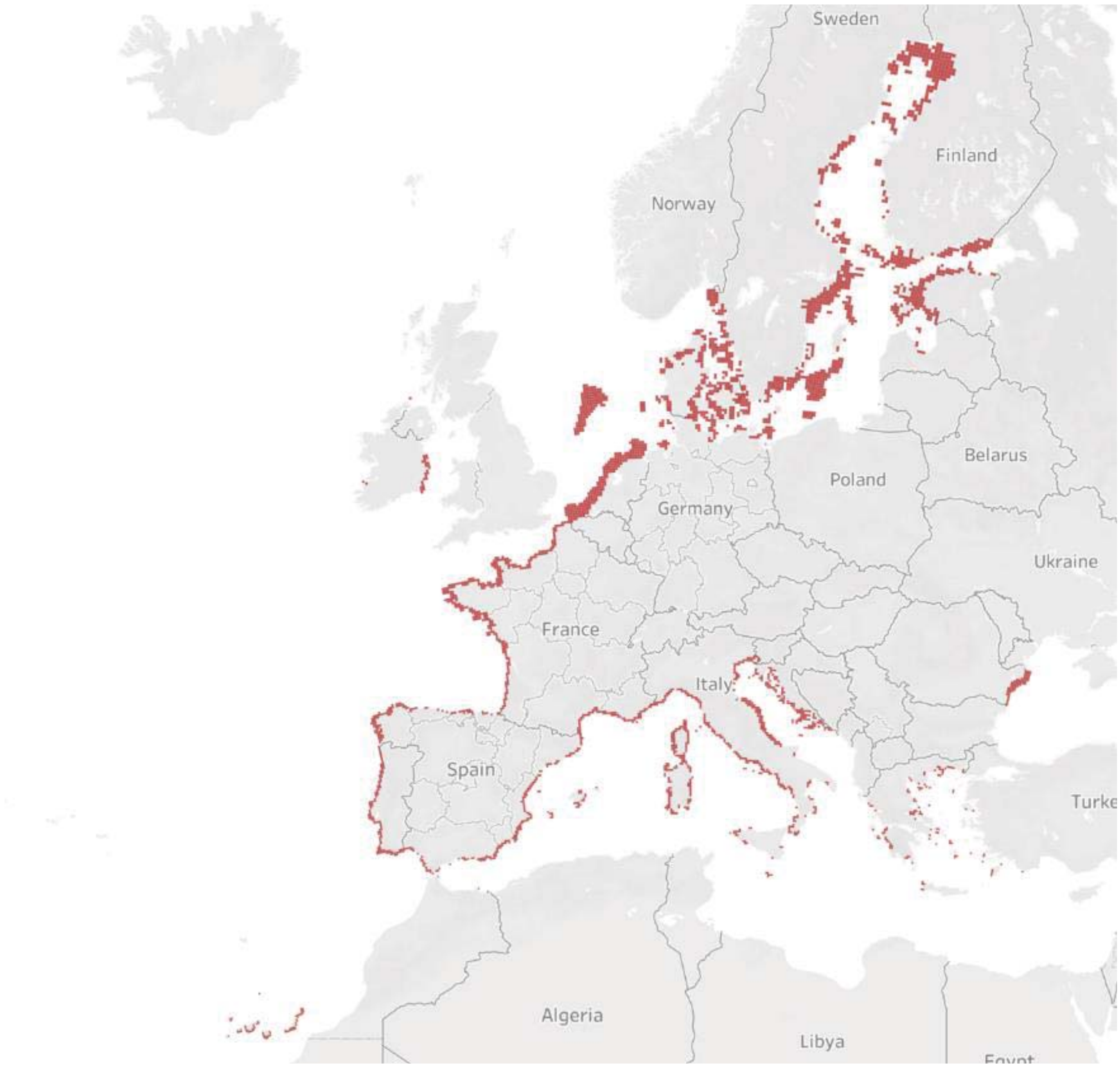
Table 5 – Condition of Annex I marine habitats per Member State

	Marine area (km^2)				Percentage		
Member State	**Total**	**Good**	**Not-good**	**Unknown**	**Good**	**Not-good**	**Unknown**
BE	4 617.0	2 750.0	477.0	1 390.0	60	10	30
BG	116.6	0.0	0.0	116.6	0	0	100
CY	398.6	433.2	0.0	-34.6	109	0	-9
DE	15 814.9	3 914.5	3 332.3	8 568.1	25	21	54
DK	17 530.8	443.8	12 083.1	5 003.9	3	69	29
EE	3 077.0	2 225.3	90.8	761.0	72	3	25
ES	12 648.7	0.0	0.0	12 648.7	0	0	100
FI	3 495.0	471.5	572.5	2 451.0	13	16	70
FR	41 067.8	16 289.5	1 693.0	23 085.3	40	4	56
GR	10 850.0	3 919.5	3 440.5	3 490.0	36	32	32
HR	798.4	0.0	0.0	798.4	0	0	100
IE	27 187.0	2 645.0	3 014.0	21 528.0	10	11	79
IT	3 980.8			3 980.8	0	0	100
LT	461.0	176.3	0.0	284.7	38	0	62
LV	1 037.8	0.0	984.5	53.3	0	95	5
MT	297.6	228.4	4.0	65.2	77	1	22
NL	12 907.0	2 671.0	8 916.0	1 320.0	21	69	10
PL	864.9	645.0	219.9	0.0	75	25	0
PT	65 290.0			65 290.0	0	0	100
RO	9 269.5	7 340.0	1 880.6	49.0	79	20	1
SE	17 590.0	0.0	0.0	17 590.0	0	0	100
SI	0.1	0.1	0.0	0.0	67	33	0

Note: (*) areas reported by Romania likely to be largely overestimated

Annex A

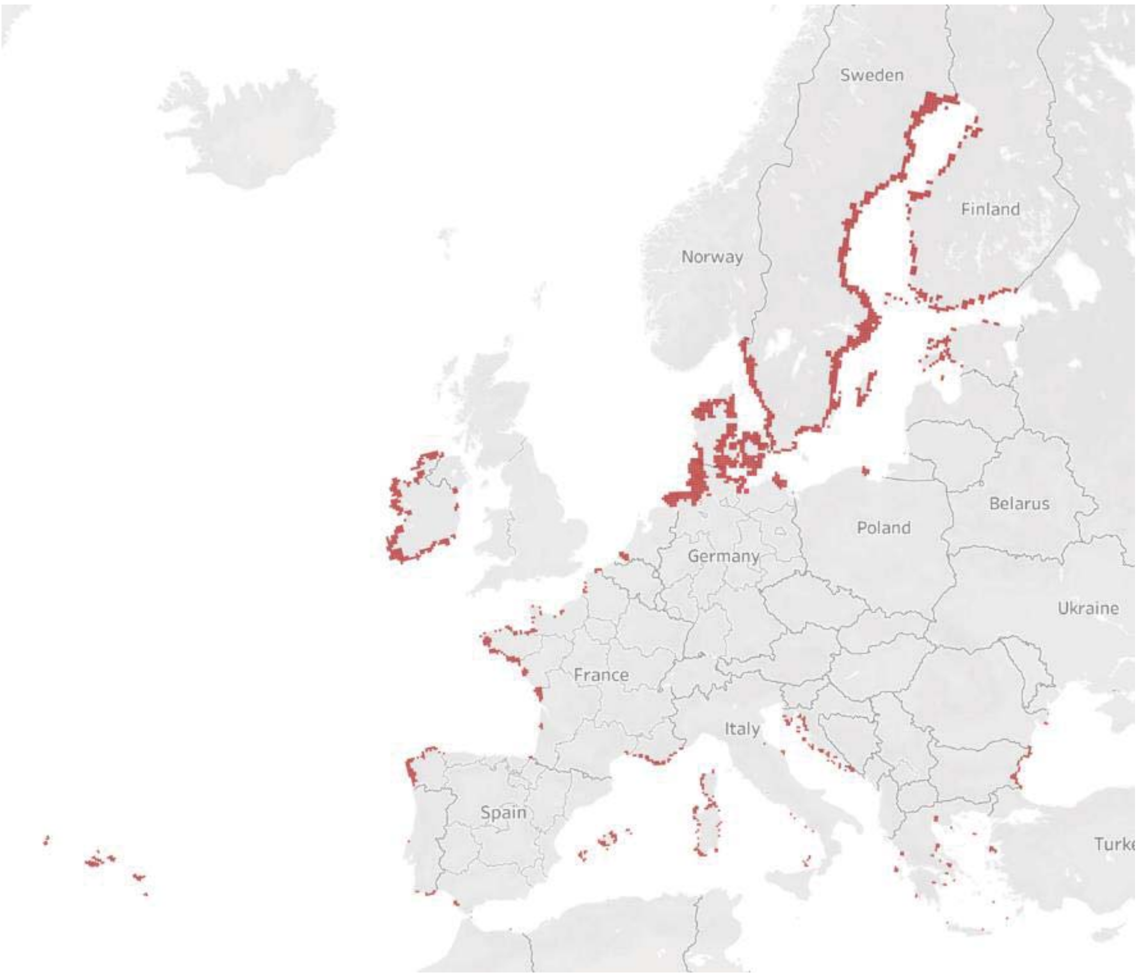
Map 2 – Distribution of habitat 1110 – Sandbanks which are slightly covered by sea water at all time



Source: European Environment Agency – April 2021

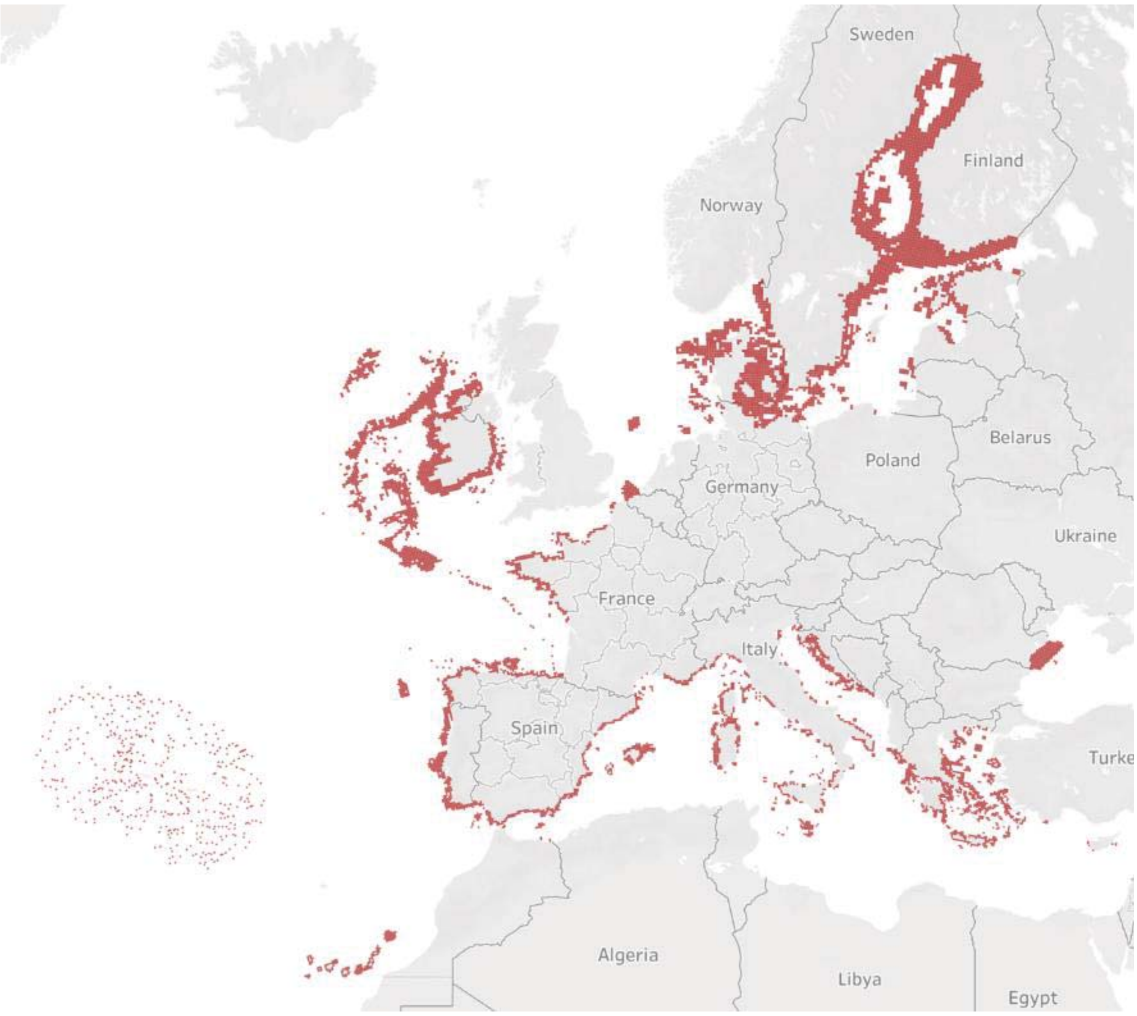
Map 3 – Distribution of habitat 1120 – *Posidonia* beds

Map 4 – Distribution of habitat 1160 – Large shallow inlets and bays



Source: European Environment Agency – April 2021

Map 5 – Distribution of habitat 1170 - Reefs



Source: European Environment Agency – April 2021

Map 5 – Distribution of habitat 1180 – Submarine structures made by leaking gases

Source: European Environment Agency – April 2021

Map 5 – Distribution of habitat 8330 – Submerged or partially submerged sea caves

Source: European Environment Agency – April 2021