European Commission

# EU ECOSYSTEM ASSESSMENT

## Summary for policymakers

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## Summary for policymakers

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*On 19 September 2020 Prof. Georgina Mace passed away. Her research has deeply inspired this report. Her scientific ideas and excellence will continue to influence how we think about nature.*

*On 25 March 2021 Leon Braat passed away. Leon was instrumental when we started the EU initiative on Mapping and Assessment of Ecosystems and their Services (MAES) in 2012. His influence on the shaping and delivery of this first EU ecosystem assessment cannot be overestimated.*

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*“Preserving and restoring our ecosystem needs to guide all of our work. We must set new standards for biodiversity cutting across trade, industry, agriculture and economic policy.”*

***Ursula von der Leyen,*** *President of the European Commission, political guidelines.*

# FOREWORD

**Healthy, thriving and resilient nature is at the core of healthy lifestyles, thriving economies and resilient societies.** Europe's ecosystems - from forests, rivers and lakes to farmland, urban green spaces and soils – form a safety net that protects us from extreme climate impacts and provides us with essential ecosystem services such as crop pollination, soil creation, carbon sequestration and storage, and much more. Access to nature is vital for our physical and mental health. Moreover, the Covid-19 pandemic has reminded us how much our own wellbeing depends on that of the planet.

While we continue to fight Covid-19 and its consequences for the global economy, the clock has not stopped ticking on the two global crises that threaten our very existence: the climate and the biodiversity crises. **These crises are fully interrelated.** The loss of natural habitats is pushing wildlife out of natural areas and to the proximity of human settlements, **increasing the risk of transmission of viral diseases and the emergence of pandemics.** Climate change accelerates the destruction of the natural world through droughts, flooding, heat waves and wildfires. Biodiversity loss and unsustainable land use impair nature's capacity to adapt to climate change and store carbon. Logically, the solutions to the health, climate and biodiversity crisis must also be interrelated.

**However, Europe's ecosystems are under increasing pressure.** This first European ecosystem assessment covering EU Member States (EU-27) and UK shows that ecosystems suffer from the increasing impacts of climate change and nutrient pollution. They are being lost to conversion and land use intensification. Native biodiversity is gradually replaced by non-native species, particularly in grasslands and urban areas. As ecosystems are destroyed, the supply of their essential services is also declining. This is costly for our economy and for our wellbeing.

Over one year ago, the Commission presented the **European Green Deal: Europe's new growth strategy to bring together environmental, economic and social sustainability**. A strategy to develop sustainable and green infrastructure, renewable energy, greener cities and healthier countryside, green products and services, sustainable agriculture and food, clean transport and innovation. This strategy for a green transition has since become our roadmap to recover from the Covid-19 pandemic.

The **EU Biodiversity Strategy for 2030** is at the heart of the European Green Deal. It is a comprehensive, ambitious and long-term plan to protect nature and reverse the degradation of ecosystems. It aims to put Europe's biodiversity on a path to recovery by 2030 including via legally binding restoration targets that we will propose later this in 2021.

**Ecosystem restoration will be essential to deliver win-win solutions for climate, biodiversity and human wellbeing by 2030.** Restoring agroecosystems will increase their natural productivity and resilience to climate change, support healthier diets and help diversify jobs in rural areas. Restoring forests, wetlands, coastal and marine ecosystems will help us mitigate and adapt to the impacts of climate change, and increase our re-

silience to natural disasters such storms, floods and drought. Restoring soil to good condition will improve their fertility, carbon storage and water regulation capacity. Restoring urban ecosystems will make our cities healthier to live in, and more resilient to climate change. Scientists need now to use the results of the first EU ecosystem assessment to develop tools and data to pinpoint places where ecosystems are degraded, and prioritise restoration.

**We have a once-in-a-generation opportunity to embrace a green transition** and emerge from this health crisis ready to set out towards a sustainable future. The UN has already declared this decade as the decade of ecosystem restoration. Later in 2021, we expect the world to agree on an ambitious global biodiversity targets at the 15th Conference of the Parties to the Convention on Biological Diversity in Kunming, China. We need to grasp this opportunity to opt for a collective recovery, for the people and the planet.

**Frans Timmermans**
*European Commission*
Executive Vice-President for the European Green Deal

# WHAT ARE ECOSYSTEMS, ECOSYSTEM CONDITION AND ECOSYSTEM SERVICES?

An **ecosystem** is a dynamic complex of plant, animal and microorganism communities and their non-living environment, interacting as a functional unit. The EU ecosystem assessment analysed the following ecosystems: urban ecosystems, agroecosystems (cropland and grassland), forests, wetlands, heathlands and shrubs, sparsely vegetated lands (beaches, dunes, rocky areas in mountains), rivers and lakes, and marine ecosystems. The boundaries between ecosystem types are often more difficult to draw than this simple classification suggests. For instance, peatlands are considered wetlands but often used and classified as forests or agroecosystems. The EU ecosystem assessment used the Corine Land Cover information system to classify (based on ***EUNIS***[1] habitat classification) and map ecosystems but for wetlands, floodplains and urban areas also dedicated boundaries were drawn. The different ecosystems cover the full EU territory.

**Ecosystem condition** is the physical, chemical and biological quality of an ecosystem at a particular point in time. Other terms that are used are ecosystem integrity or ecosystem health.

**Good ecosystem condition** means that the ecosystem is in good physical, chemical and biological condition or of a good physical, chemical and biological quality with self-reproduction or self-restoration capability, in which species composition, ecosystem structure and ecological functions are not impaired.

**Status** is defined for certain ecosystems that are covered in EU legislation: conservation status in the Habitats Directive, ecological status in the Water Framework Directive, and environmental status in the Marine Strategy Framework Directive, with a gradient of legally defined status categories.

**Ecosystem services** are the contributions of ecosystems to economic, social, cultural and other benefits that people derive from ecosystems. For instance, pollination, the provision of food, timber and clean air, water filtration, carbon sequestration and storage or nature-based recreation are all ecosystem services.

The above definitions are set in the EU Directives mentioned above (for ecosystem status) as well as in Regulation (EU) ***2020/852***[2] of the European Parliament and of the Council on the establishment of a framework to facilitate sustainable investment. They are fully in line with the ***UN System of Environmental Economic Accounting Ecosystem Accounting (UN-SEEA)***[3].

**Mapping and Assessment of Ecosystems and their Services** (***MAES***[4]) is an initiative of the European Commission and the EU Member States to increase our knowledge on ecosystems and their services in Europe. MAES provided a coherent analytical framework for the EU Ecosystem Assessment. ***ESMERALDA***[5], a Horizon 2020 project and **INCA**, an EU initiative on ecosystem accounting, have contributed to the analytical framework for ecosystems. All EU Member States have engaged in the mapping and assessment of ecosystems and their services on their territories (see the MAES ES-

MERALDA barometer of Member States' progress in ***Annex 1***).

The **EU Ecosystem Assessment** is an analysis of the pressures and the condition of terrestrial, freshwater and marine ecosystems and their services using a single, comparable methodology based on European data relative to the baseline year 2010. The assessment covers the total land area of the EU and the UK as well as the marine regions. The ecosystem assessment is carried out by the Joint Research Centre, the European Environment Agency, DG Environment, and the European Topic Centres on Biological Diversity and on Urban, Land and Soil Systems. The summary for policymakers is a synthesis of the ***scientific report***[6].

1 *https://www.eea.europa.eu/data-and-maps/data/eunis-habitat-classification*

2 *https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R0852&from=EN*

3 *https://seea.un.org/ecosystem-accounting*

4 *https://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/index_en.htm*

5 *https://oneecosystem.pensoft.net/article/29153/*

6 *https://publications.jrc.ec.europa.eu/repository/handle/JRC120383*

# 2. KEY MESSAGES

Key Message 01

## We need to preserve and restore the EU's ecosystems in order to secure their essential ecosystem services.

The EU ecosystem assessment shows that our society is increasingly dependent on the services of increasingly vulnerable ecosystems. In the EU, 3.3 million km$^2$ or 76% of terrestrial ecosystems, including forests, agroecosystems, urban green spaces and soils, are outside the scope of the EU's Habitats Directive. Many are subject to ongoing pressures from human activities and the increasing impacts of climate change and invasive alien species. Yet, these landscapes provide most of our food and timber, help regulate water flows, host insects that pollinate crops, sequester carbon or are used by people for recreation and wellbeing. The demand for all these ecosystem services has increased since 2010 but the potential of ecosystems to deliver these services is slowly declining. As a consequence, about 54% of the societal demand for regulating and cultural ecosystem services is insufficiently secured.

The gap between the demand and supply of regulating and cultural ecosystem services can be closed through targeted ecosystem restoration, in particular in places where people need ecosystems to protect them against floods, or to provide pollination, carbon storage and sequestration or recreation.

The challenges of climate change and continued biodiversity loss call for an in-depth rethinking of the current models of managing natural resources or natural capital, in order to increase nature's resilience by both scaling up protection and restoration efforts and by curbing pressures across ecosystems. This is especially pertinent in the case of marine ecosystems, whose restoration is urgently needed in the face of rising anthropogenic impacts from climate change, acidification, pollution and invasive alien species.

Key Message 02

## Effective implementation of environmental legislation and policies can result in pressures reduction and ecosystem condition improvements.

The potential of environmental legislation to bring about major improvements, if fully implemented, is demonstrated by progress in some areas such as pollution reduction, improving air and water quality, a rising share of organic farming areas, the expansion of forests, and bringing marine fish stocks to sustainable levels. For example, air and freshwater quality are showing long-term improvement trends related to the overall reduction in the application and emissions of several nutrients such as nitrogen and phosphorus. However, air and water pollution overall remain above critical levels in many areas and continue to cause harm to ecosystems and human health.

The area of forests and tree biomass is expanding. Part of this trend is linked to abandonment or conversion of valuable natural habitats to forests with increased management intensity. The amount of deadwood, a proxy for forest biodiversity, is also increasing. In agroecosystems, the share of organically farmed utilised agricultural area has increased to 7%. In the North East Atlantic Ocean, pressures on fish stocks are presently below maximum sustainable yield. These positive trends are the result of continued policy efforts to reduce pollution and to achieve a more sustainable use of marine resources.

Key Message 03

## The adverse impacts of climate change and invasive alien species on ecosystems are increasing.

Between 1960 and 2018, the average annual temperature in the EU has been rising at a rate of 0.325°C every 10 year. Effective rainfall (the difference between total rainfall and evapotranspiration by trees) is, on average, decreasing because evapotranspiration by forests is increasing. Thus, less water infiltrates in soil and is thus unavailable for water-limited ecosystem functions such as carbon sequestration. The number of extreme drought events is significantly increasing. Species respond to these changes by expanding their range upward (in mountains) or northward. Restoring ecosystems, increasing their resilience and creating corridors between natural areas will facilitate species movements and increase the coherence of the EU's nature network.

The assessment shows that all ecosystems in the EU are now substantially exposed to invasive alien species. A further reduction of pressures from invasive alien species will be essential to boost ecosystem resilience and a robust nature network of healthy ecosystems may be the first line of defence against the impacts of climate change and the spread of invasive alien species.

Key Message 04

## Improving the condition of ecosystems in the wider landscape by reducing pressures on biodiversity can help improve the status of protected habitats and species both within and outside Natura 2000 areas, and increase their connectivity.

The Natura 2000 network covers 18% of the EU land area and includes valuable and threatened species and habitats of community interest, in particular heathlands and shrubs, inland wetlands, sparsely vegetated lands such as dunes and mountain tops, rivers and lakes, and coastal wetlands. Within agroecosystems, forests, and urban ecosystems the Natura 2000 network covers the areas of highest biodiversity interest. The spatial extent of marine protected areas has been steadily increasing in the past years and currently covers more than 8% of EU's marine regions.

Improving the condition of managed ecosystems such as cropland and urban ecosystems, through measures to reduce pressures and restore biodiversity, can significantly increase connectivity, while helping to reduce disturbances on protected areas from the surrounding landscape, thus also supporting the achievement of favourable conservation status for protected habitats and species. For example, urban nature, green stripes alongside roads and other green infrastructure, as well as certain farmland habitats can support important

pools of species and habitat diversity, provide ecological corridors connecting natural areas and act as buffer zones. This makes them feasible targets for restoration and sustainable use measures that can bring biodiversity benefits as well as enhanced ecosystem services.

Key Message 05

## Pressures on forests remain high and undermine good forest condition.

Forests cover 36% of the EU land area[7], hosting a dominant part of Europe's terrestrial biodiversity, and contributing significantly to climate change mitigation. After millennia of forest use, currently only between 2% and 4% of EU forests are primary or old-growth forests. Today, most forests are semi-natural (89%). The remaining share are plantations.

There has been an increase in some structural indicators, for example forest area, biomass volume and deadwood. Forest area increased in Europe by 13 million hectares in the period between 1990 and 2015 due to both natural processes and to active afforestation. More forested area does not necessarily mean healthier and biodiverse forests. Climate change impacts are increasing. Tree cover loss from wildfires, storms and harvesting is increasing. This suggests that the harvested area of forests is likely increasing due to a higher demand for biomass.

Pollutants remain a concern even if the trends point downwards. One out of four forest trees suffers leave damage and loss. The predominant drivers are not yet fully understood, whereas parasitic insects and abiotic factors, mostly drought, are recognized as factors exacerbating this negative trend. Increased evapotranspiration suggests functional changes in forests.

Whereas a 3% decrease in the abundance of common forest birds has been reported since 1990, their status shows slightly improving trends in the last few years.

Important knowledge gaps persist with respect to biodiversity in forests, forest management intensity, as well as forests health and resilience, pointing to the need for a reinforced forest monitoring framework.

Key Message 06

## Agricultural biodiversity and soil, a vital assets for farmers, continue to decline.

Agroecosystems cover almost half of the EU land area (36.4% cropland and 11.4% grassland). The EU ecosystem assessment shows that main pressures (use of pesticides, gross nitrogen balance) have remained stable, so as the structural condition of agroecosystems, measured by indicators including landscape mosaic, crop diversity, share of dominant crop, share of high nature value farmland, and share of protected agroecosystems. Moreover, almost 600 $km^2$ of agroecosystems are lost each year due to soil sealing. Organic farming has increased reaching 7% of the utilised agricultural area. Improving trends are also marked by nitrogen concentration in groundwater and exceedance of critical loads. However, this has not been sufficient to prevent further erosion of agrobiodiversity. Since the start of the observations in 1990, the farmland bird index has declined by 33%, and the grassland butterfly index by 39%.

Agricultural soils are being lost to urban expansion, and degraded by intensive agriculture practices resulting in soil compaction, contamination, loss of organic matter and biodiversity, with increased soil erosion. Croplands and grassland soils exhibit a slight decrease in soil organic carbon stocks between 2009 and 2015 of about 0.06% and 0.04% respectively, but with marked regional differences.

Reversing negative trends in agroecosystems will depend on reducing key pressures that are still high, particularly in terms of nutrient and pesticide use. Improving the condition of agroecosystems and delivering the EU target to restore high-diversity landscape features to cover 10% of agricultural land will also be essential in order to safeguard agriculture-related biodiversity and important ecosystem services such as soil fertility, pollination and natural pest control.

Key Message 07

## Wetlands remain in poor condition. The chemical quality of rivers and lakes improved but overall progress to achieving good ecological status is insufficient.

Wetlands support rich biodiversity, store carbon, regulate water supply and quality, and help mitigate the impact of natural disasters. Despite these critical ecosystem services for human wellbeing, wetland habitats in Europe have been subject to continued loss to land drainage and conversion, and degradation due to multiple pressures, since the middle of the twentieth century. This trend is continuing. The area of inland wetlands has further declined between 2000 and 2018 due to land conversion. The remaining wetland habitats are in a very poor conservation status and the outlook is negative, with wetlands suffering from multiple pressures.

Overall, pressures on freshwater due to water abstraction and nutrient pollution have been reduced in the EU since 2000. However, the rate of this improvement has slowed down in more recent years. 39% of rivers and lakes are in good ecological status. Further reduction of pressures and implementation of restoration measures are needed to improve water quality and importantly, the physical structure, hydrological regimes and functions of freshwater ecosystems. The river network remains fragmented in two dimensions. Firstly, barriers disrupt the longitudinal connectivity of rivers and lakes: 60% of streamflow in the EU's river networks is intercepted. Secondly, the continued conversion of riparian areas and the expansion of urban areas and infrastructure disrupt the connectivity between the river bed and its floodplain. Restoring and reconnecting these areas, where feasible, can significantly improve biodiversity habitats as well as the flood protection, water purification and supply functions of these ecosystems.

Key Message 08

## Major data gaps pose obstacles to the assessment of marine ecosystem condition.

Europe's seas and oceans host the largest range of ecosystems in the entire European Union. They are hotspots of global biodiversity and provide a flow of essential goods (e.g. food) and services (e.g. climate regulation). Approximately 40% of the EU's population lives in coastal areas. Seas and oceans have shaped coastal communities' cultures, livelihoods and sense of identity.

The EU has established one of the most comprehensive marine policy frameworks in the world, the Marine Strategy Framework Directive (MSFD) with a holistic, ecosystem-based approach to protect the marine environment. However, data gaps on pressures and the condition of marine ecosystems persist. There are challenges to the analysis of trends, for example in pollution from nutrients, contaminants, and litter. There are also substantial knowledge gaps that limit our understanding of ecosystem health in the marine regions, in particular in the Mediterranean Sea and in the Black Sea. Climate change is impacting all seas through acidification and higher sea temperatures, in particular in the surface layers. Marine water quality is stable and improving across the North East Atlantic Ocean and the Baltic Sea but it is deteriorating in the Mediterranean Sea and in the Black Sea. EU fishery is becoming more sustainable, but many stocks are still overexploited. Nine percent of the area of EU coastal and marine habitats is protected under the Habitats Directive, but the share of habitat assessments showing favourable conservation status is only 2.9%.

Key Message 09

## Nature-based solutions in cities can help improve urban quality of life while minimising negative impacts on other ecosystems and improving urban biodiversity.

Urban areas have impacts that go well beyond their boundaries. As economic poles, they attract commuters from surrounding areas. These functional urban areas, consisting of core cities and the commuting zones around them, extent to as much as 22.5% of the EU land area. They mainly overlap with croplands, grassland and forests and urbanisation drives the loss of these ecosystems, increasing carbon deficits and biodiversity loss. Nature-based solutions can improve the urban environment creating benefits for both citizens and biodiversity. Such solutions span from the conservation of natural ecosystems within commuting zones to the restoration, creation and management of multifunctional green urban areas in order to improve local climate, reduce urban overheating, mitigate flooding, air pollution and biodiversity loss. The design and management of new urban nature in the core area of cities can also provide opportunities for recreation and social interaction, and significantly improve urban quality of life.

Key Message 10

## The EU needs a better performing biodiversity observation network and more consistent ecosystem condition reporting.

No ecosystem is better monitored for its biodiversity than freshwater ecosystems. The EU's Water Framework Directive (WFD) has established a network of tens of thousands of monitoring stations in rivers and lakes to monitor water plants and populations of fish and macro-invertebrates. However, none of the data that underpin the assessment of ecological status could be used in this ecosystem assessment. The data exist, but are not readily available for assessing condition and trends. Of the 132 unique indicators used in the ecosystem assessment, only two (birds and butterflies) report in a consistent and harmonised way the trends on species diversity at the European scale, and these two indicators are provided by NGOs.

Clearly, the capacity of the EU to monitor biodiversity and ecosystems needs to be enhanced. A more performant biodiversity and ecosystem monitoring system is essential, not only to support future legislation on ecosystem restoration but also to help implementing existing obligations, and to better inform and connect actions that depend on knowledge of key biodiversity and ecosystem parameters. This includes developing a common spatial dataset that relates the extent of ecosystems and habitats to the occurrence of species that fall under reporting obligations.

Increased monitoring of biodiversity and ecosystems requires an updated data infrastructure that allows access to a wide variety of information sources and produces regular updates on pressures, biodiversity, ecosystem condition and ecosystem services. The UN statistical division adopted in March 2021 an international framework for organising ecosystem data (UN System of Environmental Economic Accounting – Ecosystem Accounts, SEEA-EA). This framework can now be used as a statistical standard for tracking changes in ecosystems and ecosystem services within the EU.

*7 Based on Corine Land Cover 2018*

# 3. BACKGROUND

Europe's ecosystems, on which we depend for food, timber, clean air, clean water, climate regulation and recreation, suffer from unrelenting pressures caused by intensive land or sea use, climate change, pollution, overexploitation and invasive alien species. **Ensuring that ecosystems achieve or maintain a healthy state or a good condition is thus a key requirement to secure the sustainability of human activities and human well-being.** This guiding principle applies to all ecosystems including marine and freshwater ecosystems, natural and semi-natural areas such as wetlands or heathlands but also managed ecosystems such as forests, farmlands and urban green spaces.

Knowledge about ecosystem condition, the factors that increase or decline that condition, and the impacts on ecosystem services with the benefits they deliver to people, is key to effective management, decision-making and policy design. Such an understanding can help to better target actions for the conservation, restoration and sustainable use of ecosystems.

This ecosystem assessment extends and complements the knowledge we have about the state and trends of ecosystems reported under the EU environmental legislation. The conservation of habitats and species as well as the environmental ambition for freshwater and marine ecosystems have a well-defined thematic and geographical scope. This assessment goes beyond the scope of existing EU legislation, **covering the entire terrestrial and marine territory of the EU** and in many cases providing more spatially explicit information than what is reported under current legislation. Ecosystems within and beyond protected areas, such as coastal and inland wetlands and forests, contribute to the wellbeing of people through ecosystem services. Despite their importance, they are often negatively impacted by human activities. Bringing these ecosystems back to a good condition is key to ensure a sustainable future on our planet. Moreover, human dominated ecosystems such as farmlands and urban green spaces are also extremely important providers of provisioning, regulating and cultural ecosystem services and can sometimes host remarkable levels of biodiversity that are the basis of all ecosystem services. These ecosystems should be fully considered and integrated into solutions to bend the curve of biodiversity loss.

This assessment brings together for the first time EU-wide and commonly agreed data sets to assess the state and trends of ecosystems and their services, as well as the level and trend of pressures that they are exposed to. This is particularly important in order to understand where and how much ecosystems are degraded and threatened, so as to guide the setting of priorities and the design of cost-effective measures for their restoration.

## 3.1 AN OPERATIONAL FRAMEWORK FOR THE ECOSYSTEM ASSESSMENT

This EU Ecosystem Assessment is based on an operational framework developed by the MAES Working Group (Mapping and Assessment of Ecosystems and their Services) to implement Action 5 of the EU Biodiversity Strategy to 2020 in collaboration with policymakers and researchers. The framework is described in a series of *MAES reports*[8] and scientific articles published in the international literature. The framework was further enhanced and tested by ESMERALDA, a coordination and support action funded under the Horizon 2020 programme for research and innovation.

The MAES operational framework includes the following elements:

- **A conceptual frame** for the integrated ecosystem assessment, linking ecosystems and biodiversity to people through drivers of change and ecosystem services.
- **A common assessment framework** that describes the different steps to carry out an ecosystem assessment.
- **Typologies** for ecosystems, for pressures, for ecosystem condition and for ecosystem services.
- **A selection of indicators**, for and across ecosystem types, aiming at assessing their condition, services and pressures.
- **Analysis of baseline, short-term and long-term trends** based on a common statistical methodology and an **assessment of the uncertainty** of the data used in the assessment.

## 3.2 ECOSYSTEMS IN NUMBERS - SHARE AND TRENDS IN ECOSYSTEM AREA

### URBAN AREAS CONTINUE TO EXPAND

Marine ecosystems are the EU's most extended ecosystem type covering 5.8 million km². Forests and agroecosystems (cropland and grassland) dominate the 4.4 million km² of EU land area (EU-27 and UK). The greatest land use changes are caused by urban expansion, at a rate of 3.4% every ten years. This expansion mainly consumes cropland, which decreases at a rate of - 0.3% every ten years. The area of grassland, heathland and shrub and wetlands has also continued to decrease.

## 3.3 THE LANDSCAPE MOSAIC CAN INFORM POLICY MEASURES

A **Landscape Mosaic** map provides an overview of the spatial arrangement, composition and interactions of different land use types. As a cross-cutting indicator, it measures the degree of land use inter-

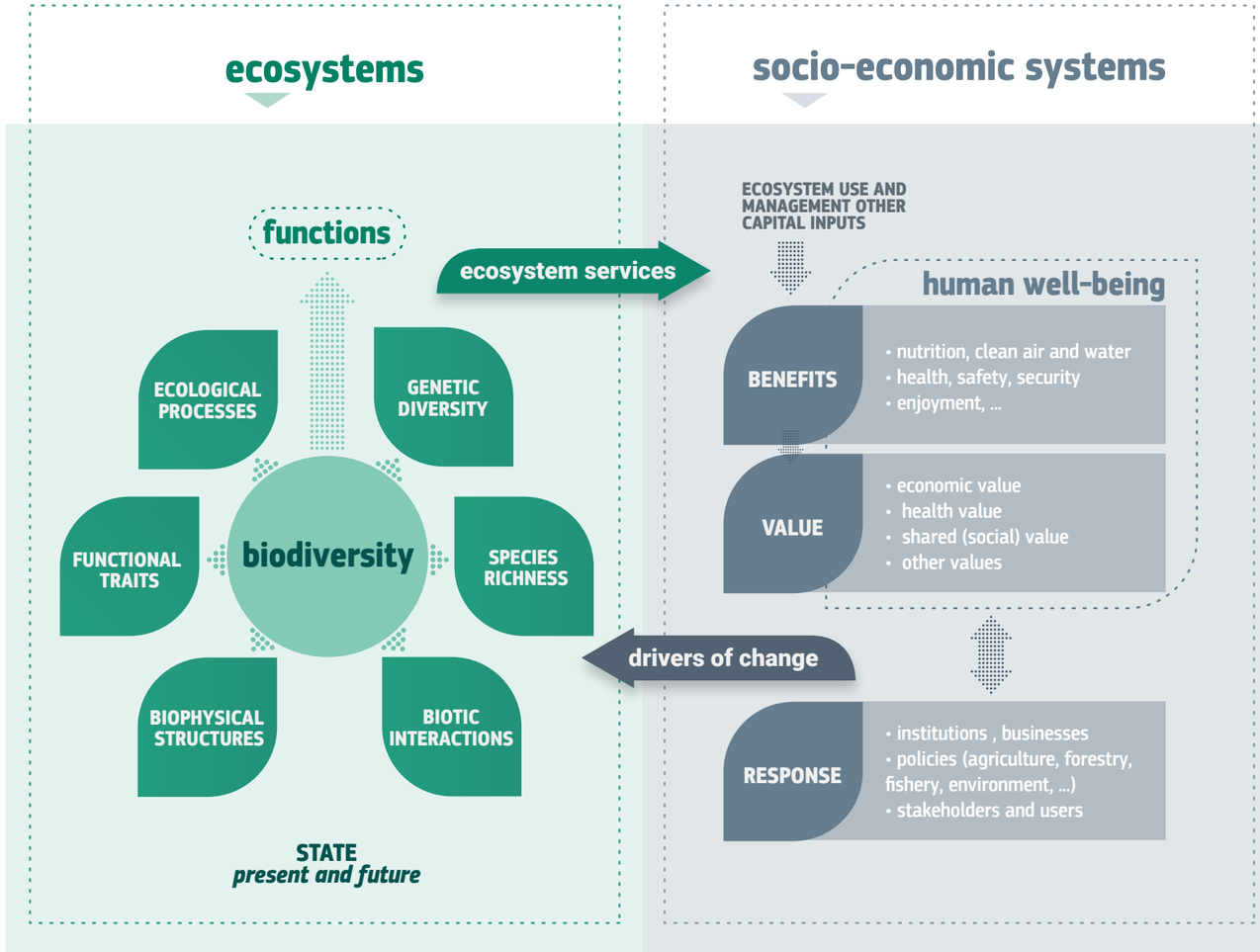



*Figure 1. Conceptual framework for Mapping and Assessment of Ecosystems and their Services.*

mix between agricultural, urban and natural areas. It provides information for landscape state and trend assessments, studies in biodiversity and green infrastructure network design. The Landscape Mosaic allows to delineate areas that would most benefit from conservation and restoration measures and shows where landscape connectivity has changed in the EU. While the statistical summary suggests a very stable situation within the EU-27 and UK between 2000 and 2018, the Landscape Mosaic map clearly highlights regional variability, serving as an important information source for policy design.

## 3.4 ONLY PART OF EU ECOSYSTEMS BENEFIT FROM LEGAL PROTECTION

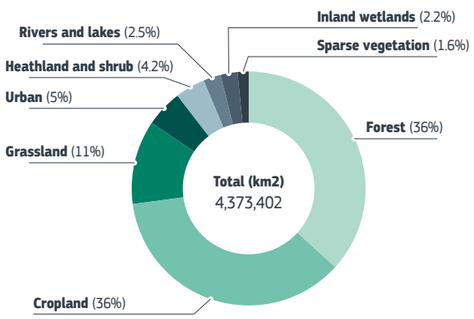
### GAPS REMAIN IN THE DESIGNATION OF PROTECTED AREAS ESPECIALLY AT SEA

Despite the importance of a wide range of EU ecosystems for the provision of essential ecosystem services to society, **only part of EU ecosystems benefit from effective legal protection.** About 24% of the area of terrestrial ecosystems and only 9% of marine ecosystems are covered by the Birds and Habitats Directives as habitats of European interest. The Natura 2000 network covers 18% of the EU land area. Ecosystems beyond the scope of the Nature Directives are mainly forests, agroecosystems and urban ecosystems. Freshwater and marine ecosystems are subject to the provisions of the Water Framework and Marine Strategy Framework Directives, while many of them are also concerned to varying degrees with the protection requirements under the Habitats Directive.

## 3.5 REPORTING UNDER EU LEGISLATION SHOWS POOR STATUS OF ECOSYSTEMS

Ecosystem status, or the condition of ecosystems that are under EU legal designation, is largely unfavourable. This conclusion is based on the data from the EU Member States reporting on the conservation status of habitats, and the chemical and ecological status of water bodies. The share of habitats assessments that show favourable conservation status remains very low and varies between 3 and 25% of the habitat areas. The share of freshwater bodies that have achieved at least good chemical status is 36%, whereas the share of those that have achieved at least good ecological status is 39%.

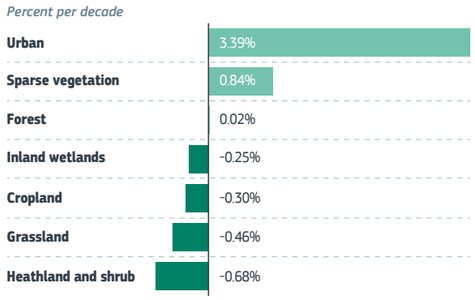
**Share of terrestrial ecosystems**




*Marine ecosystem are the most extended ecosystem type in the EU (5.8 million km²). The EU land area covers almost 4.4 million km².*

*Figure 2. The share of terrestrial ecosystems in the EU and the UK in 2018. Data source: Corine Land Cover, European Environment Agency, 2018*

**Change in ecosystem area**




*Rivers and lakes and marine ecosystem are assumed to have a stable area and are not included in this graph.*

*Figure 3. Changes in the area of terrestrial ecosystems in the EU and the UK in 2018. Data source: Corine Land Cover, European Environment Agency, 2018*

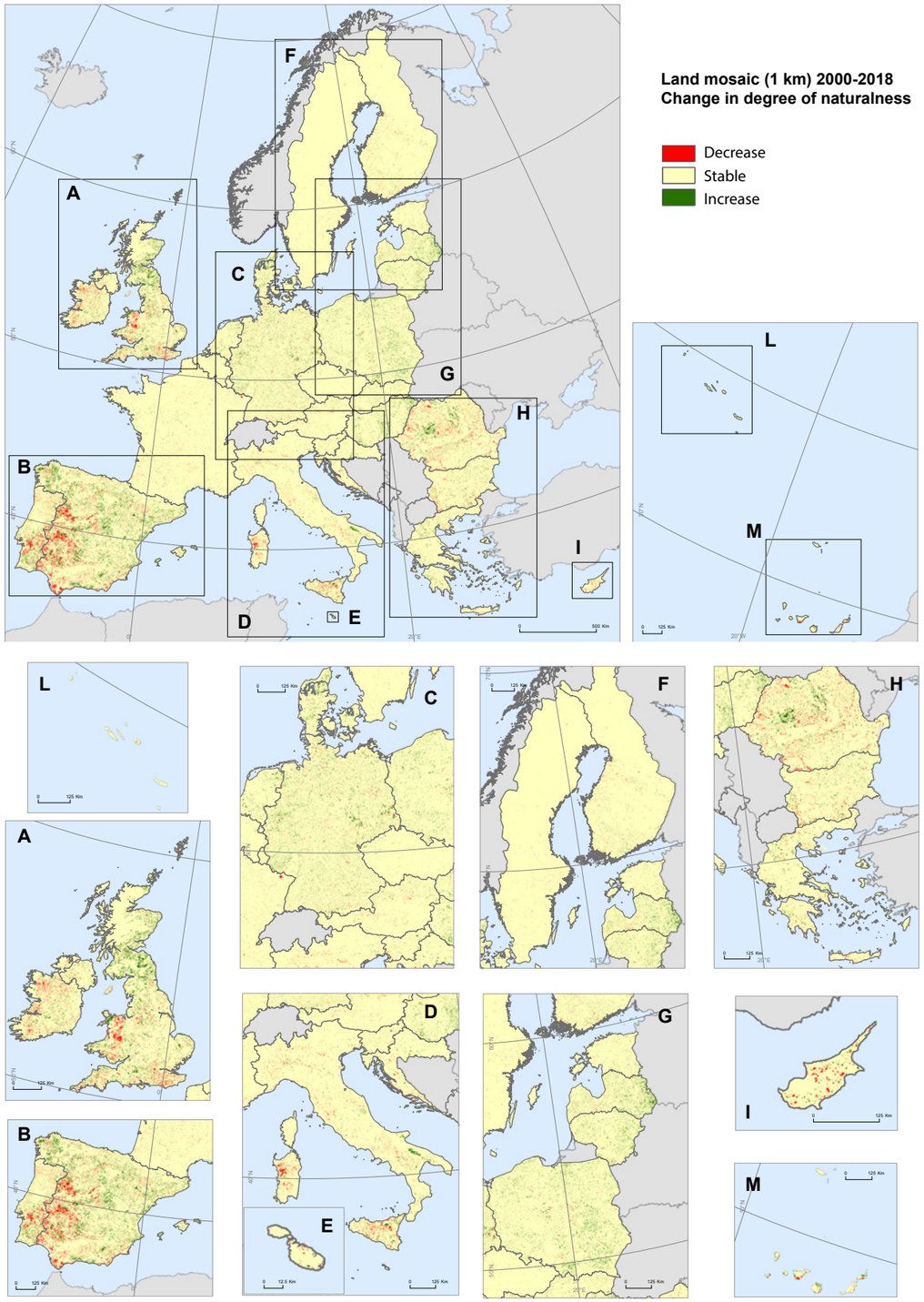



*Figure 4. Landscape mosaic (LM). Change in the degree of naturalness in the EU and the UK between 2000 and 2018*

## 3.6 KEY TRENDS IN PRESSURES, ECOSYSTEM CONDITION AND ECOSYSTEM SERVICES

The EU ecosystem assessment shows downward trends in air and water pollution and a slowdown of land consumption by built-up areas. However, the absolute values of these pressures and their impacts remain high, and further reductions are needed.

The impacts of climate change on ecosystems are increasing. Impacts of particular concern include rising land and sea surface temperatures, the reduction in effective rainfall, the higher incidence and intensity of extreme drought events, and the further acidification of marine ecosystems relative to the 2010 baseline values.

Invasive alien species are observed in all ecosystems. Their pressure is particularly high in urban ecosystems and grasslands. When considering habitats protected by the Habitats Directive, invasive alien species of Union concern are most often reported by Member States in coastal habitats, followed by forest and freshwater habitats.

Pressures from overfishing and marine pollution are high, leading to the degradation and loss of marine biodiversity and habitats.

Despite decreasing emissions of nitrogen and phosphorus to the environment, these continue to be major pressures on ecosystems as levels are still high.

**The combination of these pressures, their possible interactions with climate change and the further spread of invasive alien species pose serious threats to the EU's ecosystems and their biodiversity.**

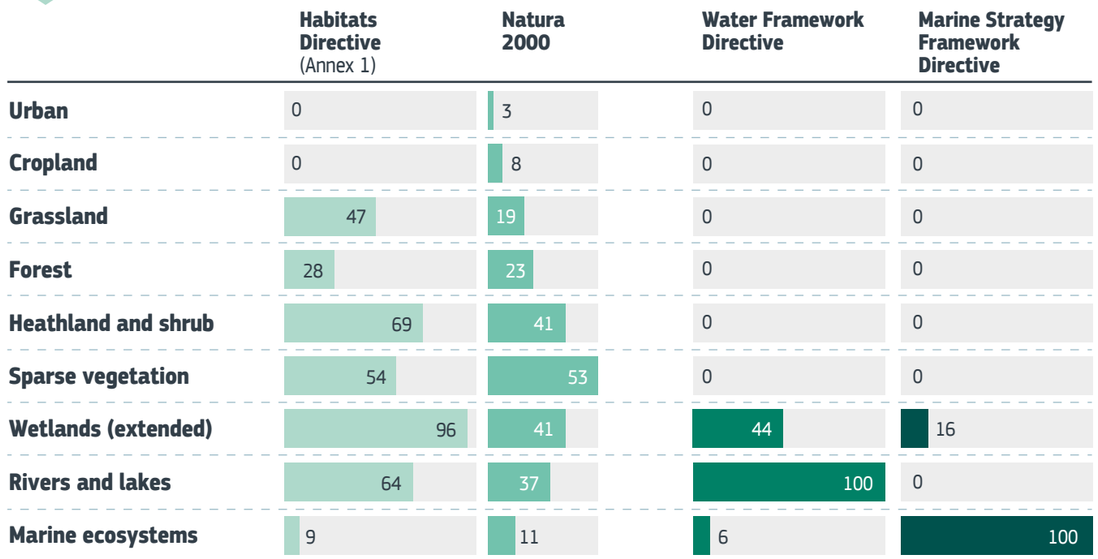
The analysis of **trends in ecosystem condition** is based on available indicators and reveals mixed trends. In the long term, **air and freshwater quality are improving**. In forests and agroecosystems, which represent over 80% of the EU land territory, there are improvements in structural condition indicators (biomass, deadwood, area under organic farming) relative to the baseline year 2010. However, some key bio-indicators such as tree-crown defoliation continue to increase indicating that **ecosystem condition is not improving. Species-related indicators show no overall improvement, and in some cases further declines, particularly in agroecosystems**.

The analysis of trends in ecosystem services concluded that **the current potential of ecosystems to deliver timber, protection against floods, crop pollination, and nature based recreation is equal to or lower than the baseline values for 2010.** At the same time, **the demand for these services has significantly increased**. A lowered potential in combination with a higher demand creates risks of further eroding the condition of ecosystems and their contribution to human well-being.

Climate change is hitting EU and its impacts are now evident across all ecosystems. The map in Figure 7 aggregates 15 bioclimatic variables related to temperature, rainfall and drought in order to highlight areas of significant pressure. It indicates that the most serious climate change-related problems are occurring in the Mediterranean biogeographical region, Hungary, Romania and Bulgaria, including more and more extreme droughts, lower effective rainfall and higher temperatures that risk increasing forest fires and resulting in further ecosystem degradation.

### Legal designation of ecosystems

*Percent area under legal designation of EU directives and the Natura 2000 network (% area)*



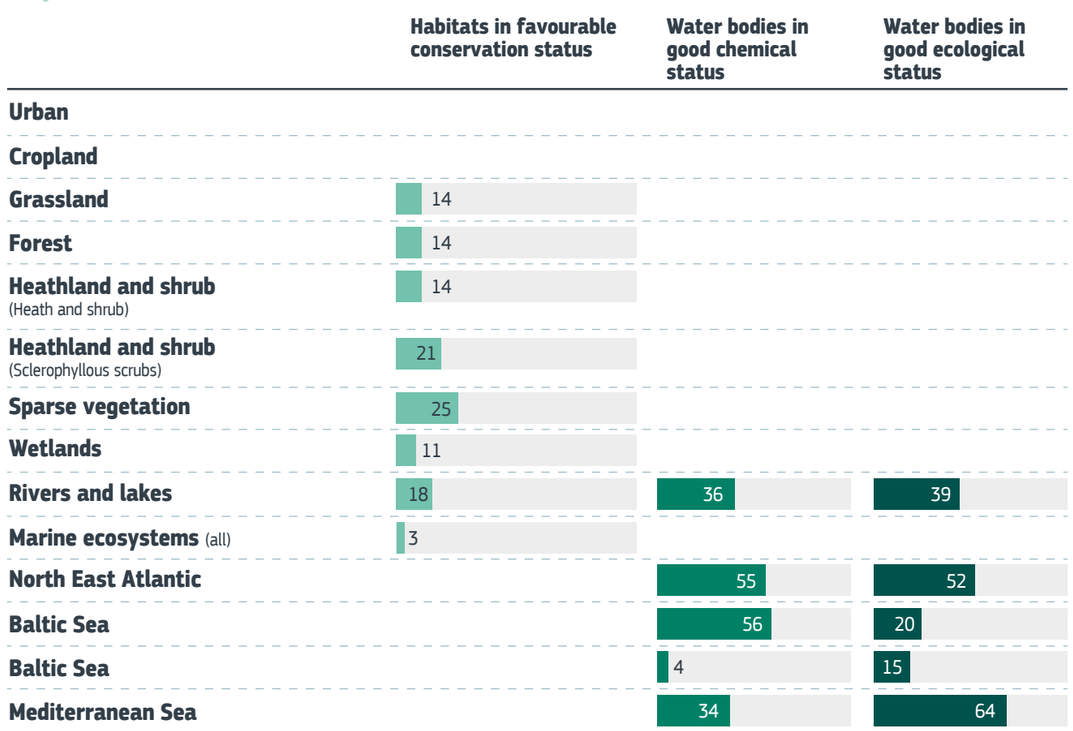

*For wetlands, the extended layer is considered for this analysis. Annex 1 habitat are habitats listed under Annex 1 of the Habitats directive. Natura 2000 is the nature protection network established under the Habitats Directive.*

*Figure 5. The relative share of ecosystems covered by the Habitats Directive, the Water Framework Directive and the Marine Strategy Framework Directive.*



### Ecosystem status

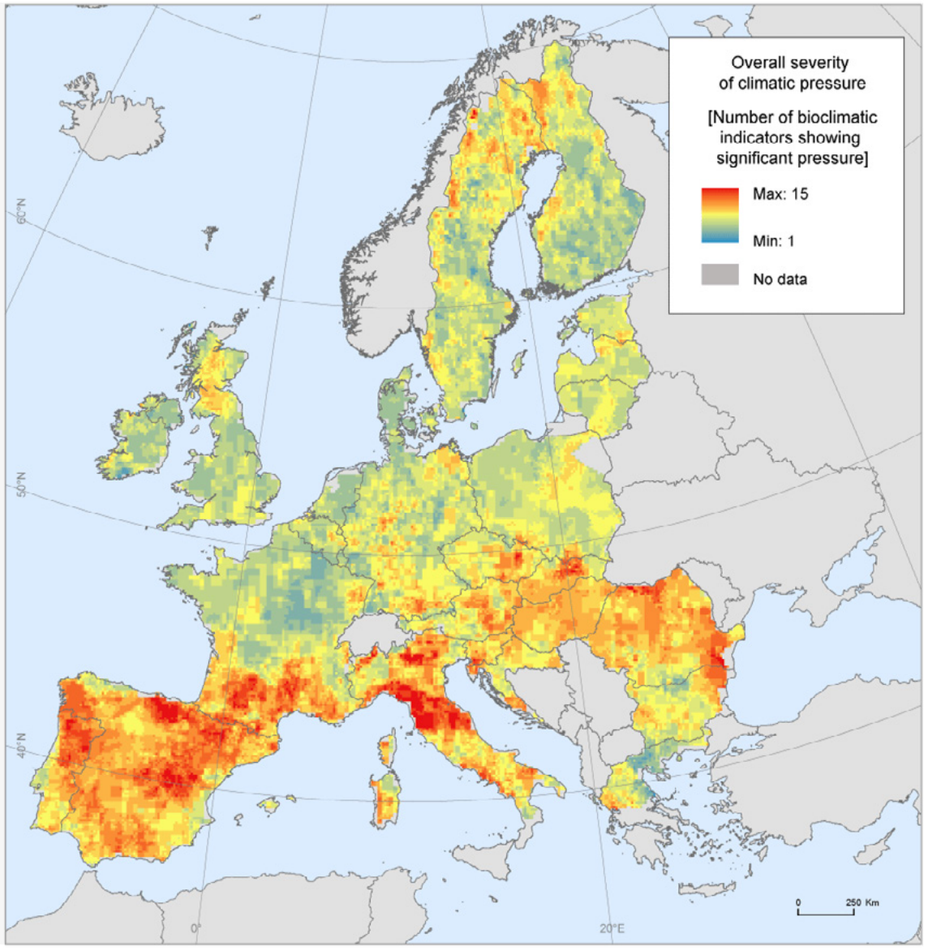
*Percent good ecosystem status under the Habitats Directive and the Water Framework Directive (%)*




*Heathland and shrubs are reported under two habitat types. For marine ecosystems, habitat conservation status is combined for all marine regions. Data on chemical and ecological status reported for the marine ecosystems only refer to the coastal waters.*

*Figure 6. The share of habitats in favourable conservation status and the share of water bodies in good chemical and ecological status.*

*Figure 7. Overall severity of climatic pressures on ecosystems in the EU*




## Invaded ecosystems

*Share of ecosystems invaded by invasive alien species (% of the total area). This figure is based on a list of 49 species of "union concern". This list is regularly updated and the species are subject to concerted actions at EU level.*

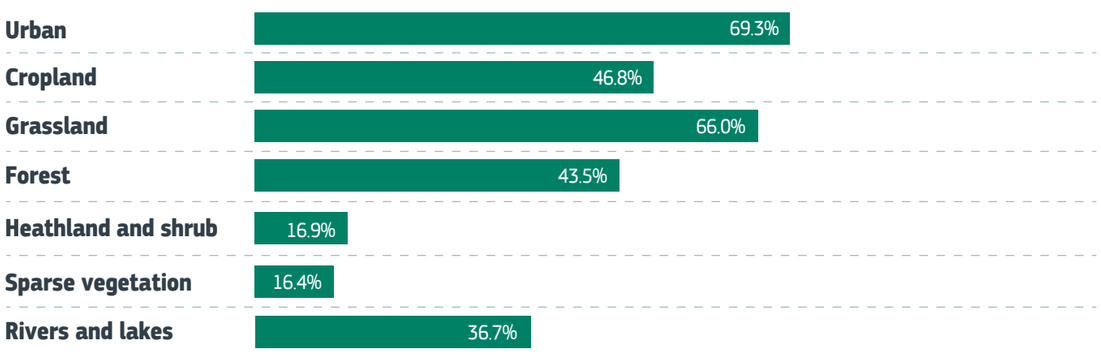



*Figure 8. Pressure on ecosystems by invasive alien species.*

Invasive alien species are observed across all ecosystems, but they have spread most widely in urban areas and grasslands. These species pose significant threats to native biodiversity and ecosystems, and hence also on ecosystem services. The impacts of invasive alien species on biodiversity and ecosystem services are complex and often take substantial time to become evident. Risk assessments to determine the potential environmental, social and economic impacts of invasive alien species are essential to inform their inclusion on the list of "Union concern". Assessing the condition of invaded ecosystems can help to identify priority areas and the need for intervention measures.

*8 https://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/index_en.htm*

# Main trends in pressures and condition

| | Land take | Climate | Pollution | Overexploitation | Invasive Alien Species |
|---|---|---|---|---|---|
| Urban ecosystems | ↗ | | ↘ | | |
| Agroecosystems | → | ↗ | ↘ | | |
| Forest | → | ↗ | ↘ | → | |
| Inland wetlands | ↗ | ↗ | ↘ | → | |
| Heathland and shrub | ↗ | ↗ | ↘ | | |
| Sparsely vegetated land | ↗ | | | | |
| Rivers and lakes | → | | ↘ | → | |
| | | | | | |
| North East Atlantic | | ↗ | | ↘ | |
| Baltic sea | | ↗ | | ↘ | |
| Black sea | | ↗ | | → | |
| Mediterranean sea | | ↗ | | → | |

## Pressures on ecosystems

*'Average' trend based on summary table*

- ↗ ***Increasing** pressure*
- → ***Continuing** pressure*
- ↘ ***Decreasing** pressure*

| | Environmental quality | Ecosystem structure | Ecosystem fuction | Biodiversity | Progress to nature targets |
|---|---|---|---|---|---|
| Urban ecosystems | ↗ | ↘ | | | |
| Agro ecosystems | ↗ | → | ↗ | ↘ | → |
| Forest | ↗ | ↗ | → | → | → |
| Inland wetlands | | ↘ | | | → |
| Heathland and shrub | | | | | → |
| Sparsely vegetated land | | | | | → |
| Rivers and lakes | ↗ | → | | | → |
| | | | | | |
| North East Atlantic | ↗ | → | | ↗ | |
| Baltic sea | ↗ | → | | ↗ | |
| Black sea | ↗ | ↘ | | ↗ | |
| Mediterranean sea | → | ↘ | | ↗ | |

## Condition

*'Average' trend based on summary table*

- ↗ ***Increasing** trend*
- → ***Stable** (no changes)*
- ↘ ***Decreasing** trend*

*Figure 9. Summary of the trends in pressures and condition of ecosystems.*

# ECOSYSTEMS

3.7

# FORESTS

MAIN FINDINGS

Healthy forests sequester and store large amounts of carbon in biomass both below and above the ground, and provide habitats to biodiversity.

Forests show some encouraging trends in relation to area coverage and deadwood. However, overall pressures such as acidification, eutrophication, drought, warming, and tree cover loss remain high undermining forest condition.

There is an increasing defoliation trend. Above 25% of forest trees show defoliation levels indicating damage.

Degraded forests need to be urgently restored to increase their resilience. Remaining primary forests are extremely rare, and a heritage in need of strong protection.

*"When we lose forests, we don't 'just' lose green space or natural habitat. We lose a key ally in our fight against climate change."*

***Ursula von der Leyen,** President of the European Commission, political guidelines 2021*

**Forests** are the largest terrestrial ecosystem in the EU. They host most of Europe's terrestrial biodiversity and contribute significantly to carbon sequestration and storage. Most forests in the EU are semi-natural and less than 3% of the EU's total forest area is covered by primary forests.

Climate change impacts are increasing. Tree cover loss from wildfires, storms and harvesting is increasing. This suggests that the harvested area of forests is likely increasing due to a higher demand for biomass.

Likewise, pollutants remain a concern even if the trends point in the right direction. Invasive alien species and insect infestations are a serious concern. Effects of pressures are evident in forest condition which is, on average, degrading. One out of four trees show defoliation levels indicating damage. Furthermore, trends point to increasing defoliation.

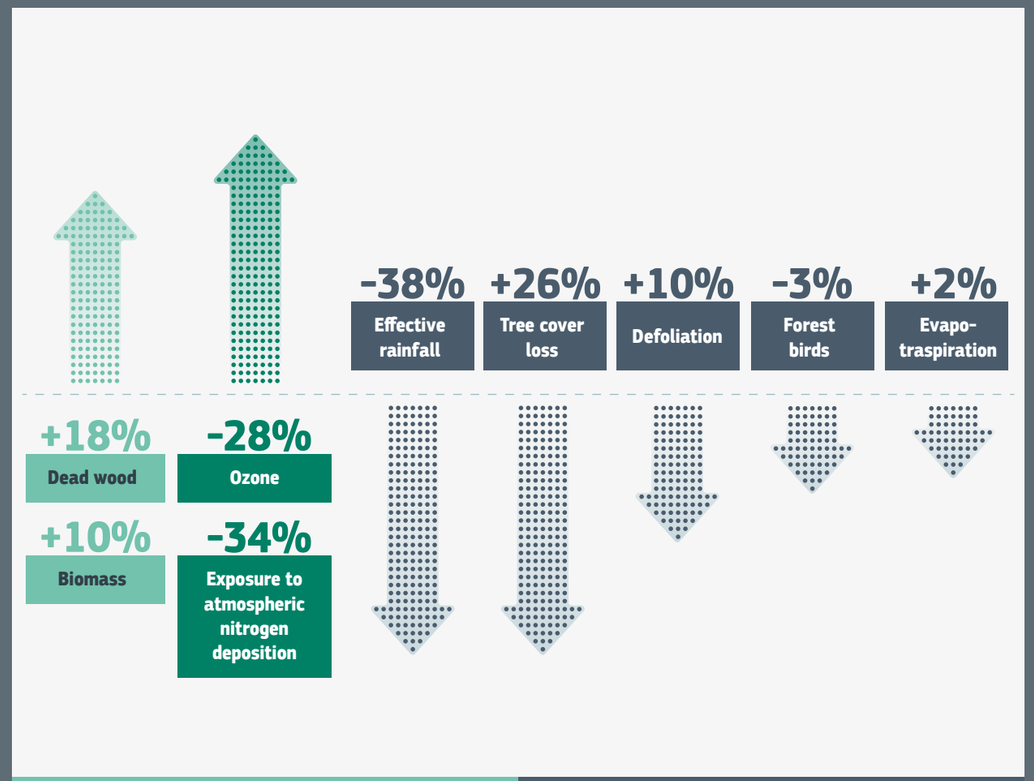
At the same time, some structural indicators of condition have shown improvement, notably an increase in forest area (but not in forested land cover), in biomass volume and in deadwood. Likewise, ecosystems productivity is increasing.

The abundance of common forest birds has not shown significant long-term changes, with a 3% decrease reported since 1990. The ratio between forests protected for biodiversity and forests available for wood supply in the EU-28 is 1:6. In other words, for each square kilometre of forests protected for biodiversity there are six square kilometres of forest potentially available for the supply of wood.



# Long-term trend in forests

*% change of key indicators over 10 years*




***Progress:***
- *Increasing forest biomass and productivity*
- *Less pollution*

***Reasons for concern:***
- *Climate impacts*
- *Forest biodiversity and defoliation*

***Legend***

Ecosystem improvement | Positive trend but sustainable level not reached | Ecosystem degradation

3.8

# AGROECOSYSTEMS

Agroecosystems have continued to degrade since 2010, as clearly shown by available biodiversity indicators. Even in the baseline year, the condition of agroecosystems was already compromised by long-term degradation and important biodiversity losses. Vital regulating services such as pollination have also declined.

Pressures on agroecosystems from intensive agricultural practices such as chemicals pollution and habitat removal have contributed to biodiversity loss over decades. These pressures are to a large degree unchanged, or increasing.

With the added and increasing pressures from a changing climate, invasive alien species and urban expansion, the reversal of biodiversity trends and the improvement of agroecosystem condition will require urgent, determined and targeted measures.

Restoring and maintaining agroecosystems in good condition requires major reduction of pressures, which in turn depends on balancing the management of natural resources and biodiversity, agricultural production and the supply of a set of ecosystems services. Finding this balance is imperative in order to safeguard the natural capital that can support the needs of current as well as of future generations.

Agroecosystems, cropland and grassland, are communities of plants and animals interacting with their physical and chemical environments that have been modified by people to produce food, fibre, fuel and other products for human consumption and processing. Over the course of centuries, agroecosystems have been shaped by extensive agricultural production practices that have supported rich biodiversity while providing a range of provisioning, regulating and cultural ecosystem services. The abandonment of these practices in some areas has led to the loss of traditional agroecosystems of high biodiversity value. In parallel, the intensification of agricultural practices has maximised agricultural production. While this has delivered an efficient production of safe and affordable food ensuring food security for the society, it has also adversely affected the condition of agroecosystems and their capacity to deliver regulating services.

The exceedance of critical loads for acidity and eutrophication and nitrogen concentrations in groundwater have decreased since 2010. However, both pressures are still at unsustainable levels across Europe. Gross nitrogen balance and pesticide use have remained stable. Organic farming has steadily increased and is covering 7% of the utilised agricultural area. Urban growth has continued to consume agricultural land in functional urban areas at steady, although slightly reduced, rates.

The impact of climate change is increasing. Agro-climatic zones in Eastern and North-eastern Europe are shifting northward at a rate of up to 100 km per 10 years. The Atlantic agro-climatic zone is moving eastward. 46% of cropland and 66% of grasslands are impacted by invasive alien species of union concern, and the situation is likely to become worse as climate change is projected to intensify processes underlying biological invasions.

Surveyed biodiversity (birds, butterflies, protected habitats) shows declining trends. Structural parameters characterising farmland (crop diversity, high nature value farmland) have remained stable around the 2010 level, as has the share of agroecosystems under protection by EU and national legislation.

Restoring and maintaining agroecosystems in good condition is essential in order to safeguard regulating ecosystem services that are essential for agriculture productivity (such as pollination, soil formation, water and nutrient cycle regulation and natural pest control) and for society at large (such as carbon sequestration and storage). This will require reducing key pressures and balancing the management of natural resources and biodiversity, agricultural production and the supply of a set of ecosystems services.

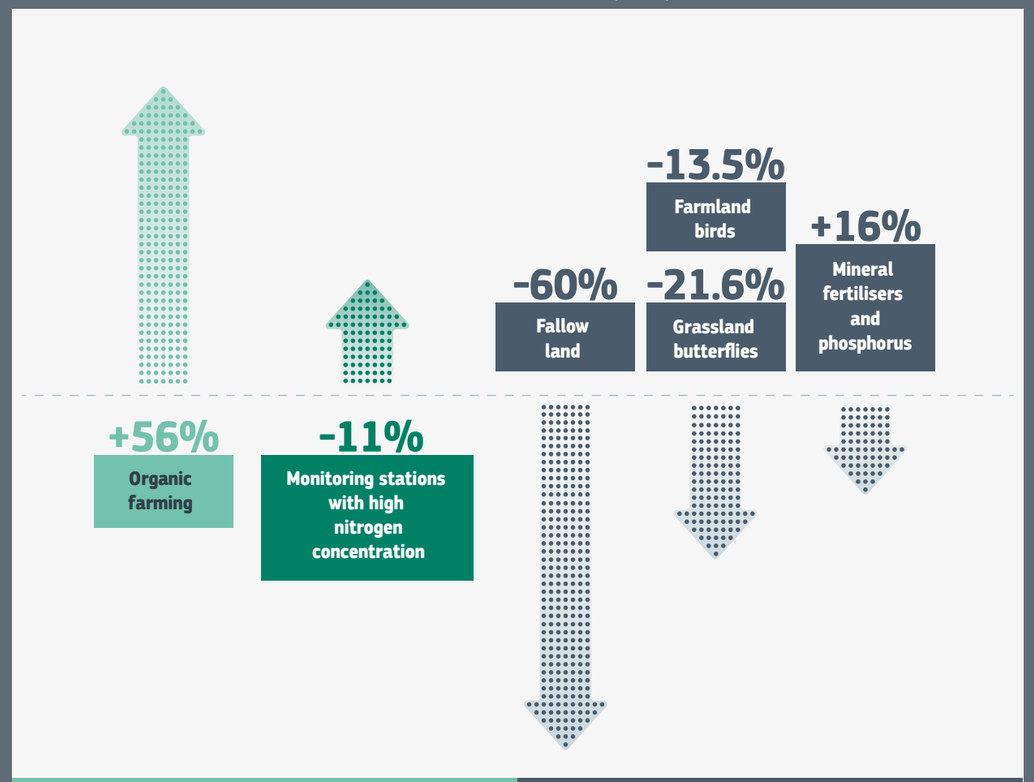
Finding this balance is imperative in order to safeguard the natural capital that can support the needs of current as well as of future generations.



# Long-term trend in agroecosystems

*% change of key indicators over 10 years*

(short-term trends for mineral fertiliser and phosporus)




***Progress:***
- *Area under organic farming increased*
- *Ground water quality increased*

***Reasons for concern:***
- *Farmland biodiversity continues to decline*
- *Too much fertilisers*
- *Too much pesticides*
- *Climate change impacts*

***Legend***

Ecosystem improvement | Positive trend but sustainable level not reached | Ecosystem degradation

INFOGRAPHIC

# CLOSING THE POLLINATION GAP THROUGH ECOSYSTEM RESTORATION

## PRESSURES IN AGROECOSYSTEMS

FERTILIZER + PLANT PROTECTION PRODUCTS + LACK OF SEMI-NATURAL VEGETATION + CLIMATE CHANGE

## POLLINATORS DECLINE

GRASSLAND BUTTERFLY INDEX
DECLINE 39%

GOOD HABITATS FOR POLLINATORS
DECREASE BY 1% PER DECADE

## IMPACT ON CROP PRODUCTION

**51%**
OF THE POLLINATOR-DEPENDENT CROPS IN THE EU HAVE **POLLINATION DEFICIT**

PRODUCTIONS

OH!NICE PLACE TO WORK!

## ECOSYSTEM RESTORATION

1 REDUCE PRESSURE ON ECOSYSTEM

2 INCREASE POLLINATOR-FRIENDLY HABITATS



3.9

# HEATHLANDS AND SHRUBS, SPARSELY VEGETATED LANDS

MAIN FINDINGS

- Heathlands, shrubs and sparsely vegetated lands including beaches, dunes and mountain highs are biodiversity-rich ecosystems that are favourite places for recreational activities such walking, hiking, cycling, bathing or active winter and summer sports.

- Heathlands and shrubs are particularly vulnerable to land take, excessive nitrogen inputs, and climate change increasing fire risk.

- Reducing pressures to no-harm levels and restoring these valuable ecosystems to good condition is essential for nature as well as for human wellbeing.

Heathland and shrub ecosystems are strongly dependent on human interventions and land-management practices, in particular grazing, mowing and controlled fires. Due to this historical relation with traditional pastoral practices, they occupy an intermediate position in vegetation dynamics, between more intensively managed grassland types and mature woodlands. They also host specific biodiversity which has adapted to human activities, and provide a high diversity of environmental, social and cultural ecosystem services, such as water provision, flood protection, carbon storage and aesthetic/recreational value, in addition to their economic value for tourism and grazing. Heathlands, shrubs and sparsely vegetated lands are distributed across all biogeographic regions of Europe, from the Mediterranean to the Boreal regions, and from lowlands to high altitudes.

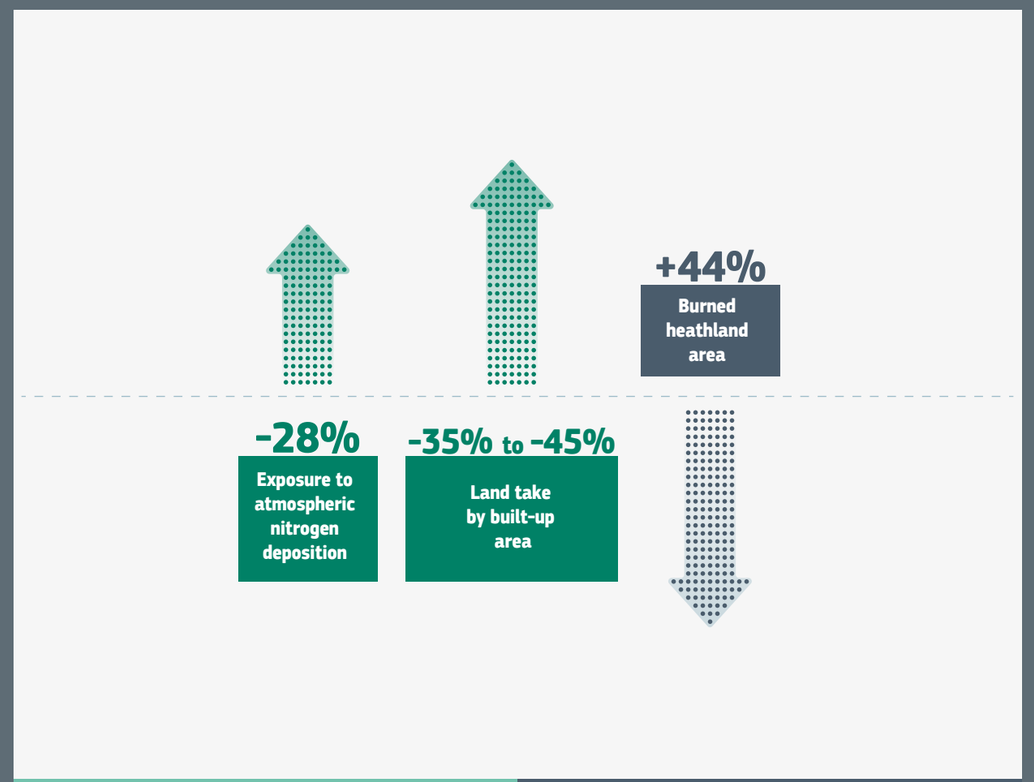
Habitat conversion and land take pressures have strongly affected heathland and shrub ecosystems in the past. These pressures have decreased over the last decades, and these ecosystems are now benefiting from a certain level of protection as part of the EU Natura 2000 network.

It is essential to concentrate efforts on restoring these ecosystems to improve their condition, in particular through the development and support of extensive agro-ecological farming systems. In some mountain or coastal areas, these important biodiversity habitats can also be highly attractive for leisure and tourism, which can be a risk if not regulated to minimise potential adverse impacts.



# Long-term trend in heathlands and shrubs, sparsely vegetated lands

*% change of key indicators over 10 years*




***Progress:***

- *Decreasing eutrophication and a slowdown in land take but the pressure levels are still too high*

***Reasons for concern:***

- *Ecosystems with a high vulnerability to land-use change, excess nitrogen*
- *Climate change*

***Legend***

Ecosystem improvement | Positive trend but sustainable level not reached | Ecosystem degradation

3.10

# WETLANDS

Wetland habitats are in a very poor condition in Europe turning unsustainably managed wetlands into net emitters of carbon.

A coherent policy framework including an inclusive and consistent definition[9] across policy areas (e.g. environment, climate) is lacking and urgently needed for effectively protecting, managing and restoring wetlands, as wetlands have insufficiently profited from an ecologically-sound, legal designation under the EU environmental directives.

Degraded wetlands, if effectively restored, regain their functional capacity to provide major ecosystem services for the benefit of biodiversity, human health and the climate, namely richer flora and fauna, flood regulation, and carbon sequestration.

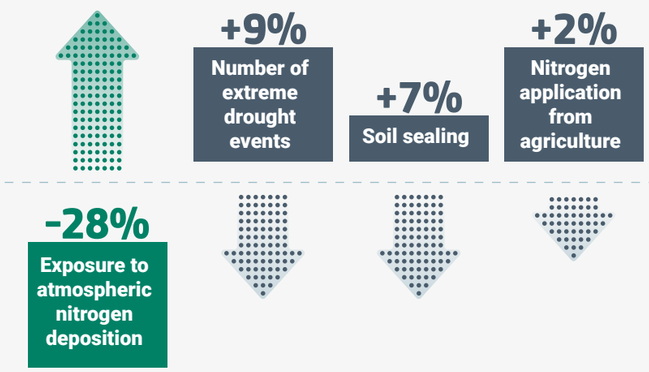
*9 A definition consistent with the Ramsar Convention on Wetlands of International Importance, especially as Waterfowl Habitat and Communication from the Commission to the Council and European Parliament – wise use and conservation of wetlands, 1995 is proposed in the draft delegated acts published for public consultation under the EU's Taxonomy Regulation for sustainable investment in activities that substantially contribute to climate change mitigation or climate change adaptation (OPC finishes on 18/12/2020)*

The current policy frameworks, although in principle fit for their purpose, do not always define wetlands properly; inland wetlands (peatlands and marshes) currently cover about 2% of the EU land area, but an extended wetlands definition that also includes coastal wetlands and other wet ecosystems, yields a percentage that is four times higher. Despite the broad range of services that healthy **wetlands provide to human livelihoods, wetlands represent the ecosystem in Europe with the worst condition**. Historically, wetlands have been suffering from a continued degradation of their habitats from multiple pressures mainly by drainage and conversion into agricultural land and forests. **Considering they are already in a poor condition**, the wetlands assessed by underpinning data show no improvement in the last two decades, with **current trends showing** either no changes or **yet further degradation**. Moreover, **multiple pressures on wetlands are high** and do not seem to decrease but rather remain unchanged. Indeed, among the indicators assessed, only nutrient enrichment shows a significant decrease linked to effective regulation.



# Long-term trend in wetlands

*% change of key indicators over 10 years*




***Progress:***
- *Decreased nitrogen deposition*

***Reasons for concern:***
- *Habitat conversion*
- *Agricultural intensification*
- *Climate impacts*
- *Unfavourable habitat conservation status*

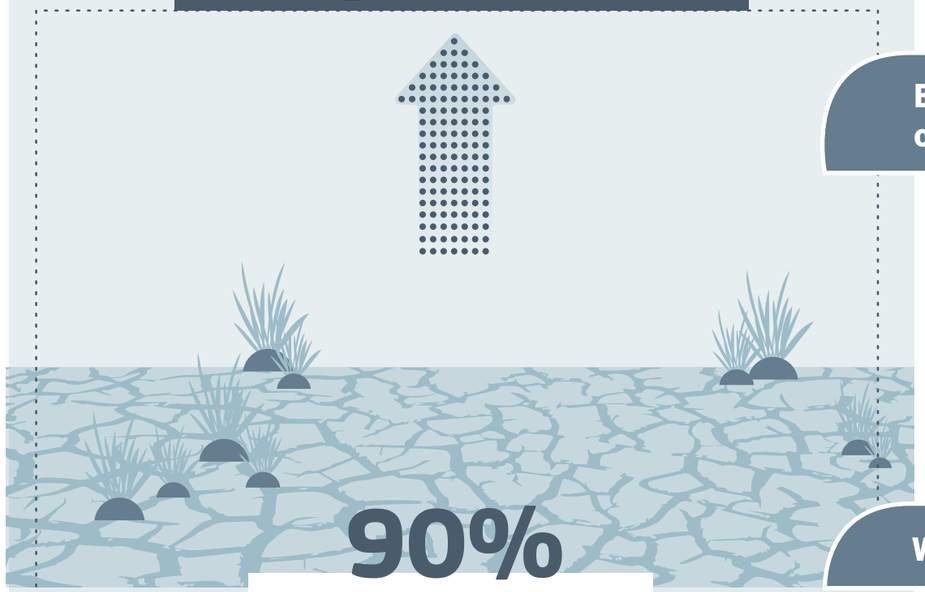
***Legend***

Ecosystem improvement | Positive trend but sustainable level not reached | Ecosystem degradation

INFOGRAPHIC

# CO-BENEFITS OF WETLAND RESTORATION AS KEY NATURE-BASED SOLUTION

## $CO_2$ emissions



**90%**

OF WETLAND HABITATS ARE IN POOR-BAD CONSERVATION STATUS

VERY SMALL SIGNS OF IMPROVEMENT

**0.5%**

WETLAND LOSSES
(2000-2018)

FOREST AND SEMI-NATURAL VEGETATION

AGRICULTURE

REDUCTIONIST VIEW OF WETLANDS
Peatbogs, inland marshes

**EU policies coordination**

**DIRECTIVES:**
Habitats Directive
Birds Directive
Water Framework Directive
Marine Strategy Framework Directive

**Wetland restoration**

**Improve knowledge**

**Comprehensive approach**

## $CO_2$ sequestration

CO-BENEFITS

NATURE-BASED RECREATION

BIODIVERSITY

FLOOD CONTROL

ENHANCEMENT OF NATURAL CAPITAL

BROAD VIEW OF WETLANDS
marshes, wet grasslands and peatlands, floodplains, rivers and lakes, saltmarshes, intertidal mudflats and seagrass beds

3.11

# URBAN ECOSYSTEMS

## MAIN FINDINGS

- Urbanisation continues in Europe: the share of urban population and land consumption are increasing.
- Urban ecosystems are heavily modified ecosystems. This means that their capacity to provide ecosystem services can be severely impaired, while at the same time demand can be particularly high.
- Citizens need urban ecosystem services: clean air, protection from flooding events, local climate regulation (such as reduction of the urban heat island effect), and access to nature for recreation, relaxation and socialising. Maintaining a sufficient urban vegetation cover and green spaces in good ecosystem condition is essential to continue providing these ecosystem services.
- Lifestyle changes and local planning policies are essential in order to ensure sustainable use of land, access to nature and sufficient multi-functional urban ecosystems, while minimising the impacts of urbanisation on ecosystem condition and services in urban and natural areas.

*"We longed for green spaces and cleaner air for our mental health and our physical wellbeing."*

**Ursula von der Leyen,** *President of the European Commission, State of the European Union 2020*

Urban ecosystems are socio-ecological systems where most people live. They include cities and their suburbs. Although they are almost completely artificial, they usually include, in different proportions and different ecological condition, all other ecosystem types: forests, lakes and rivers, or agroecosystems.

Urbanisation is growing in Europe. The share of urban population has increased by 6% since 2010. In 2018, artificial land covered 5% of the EU land area. Urban areas have undergone significant unsustainable land use development over the last decade: increased soil sealing (+1.46%), more dispersed settlements (+11%), an increase in mixed-use of land (land without one specific dominant land use) (+0.75%) and a loss of peri-urban agroecosystems (-1.5 %). These changes affect the structure of urban green spaces and consequently their capacity to provide ecosystem services. The vegetation cover in urban green spaces is characterised by a negative balance between abrupt changes of greening and browning (from -4.36 to -6.36% in densely built zones). Abrupt changes are normally due to human inputs and land use change. Abrupt greening often depends on intense green management (trees transplantation, irrigation); abrupt browning usually depends on land take and land conversion. One of the reasons can be the lack of consistent policy priorities to minimise or compensate for the loss of vegetation and urban green spaces.

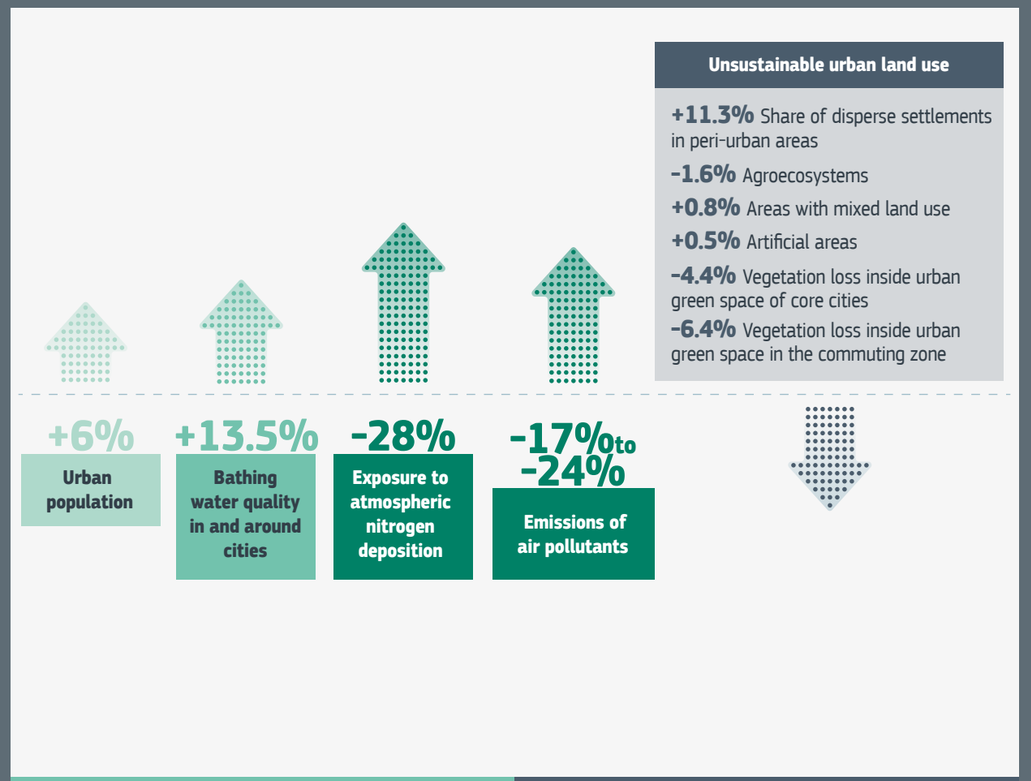
Some indicators of urban ecosystem condition point to improvements. Emissions of a number of air pollutants caused by traffic, industry and heating are decreasing (-22.7% NO; -24% NMVOC, -16.7% PM10) but the absolute values are still very high and trends are not geographically homogenous.

Halting the degradation of urban ecosystems and ensuring adequate access to nature and a sufficient flow of ecosystem services is essential for urban quality of life. This will require a systematic approach to urban development planning and investment. Minimising and compensating land take is fundamental for preserving ecosystems, both within the urban core areas and in the periphery.



## Long-term trend in urban ecosystems

*% change of key indicators over 10 years*




***Progress:***

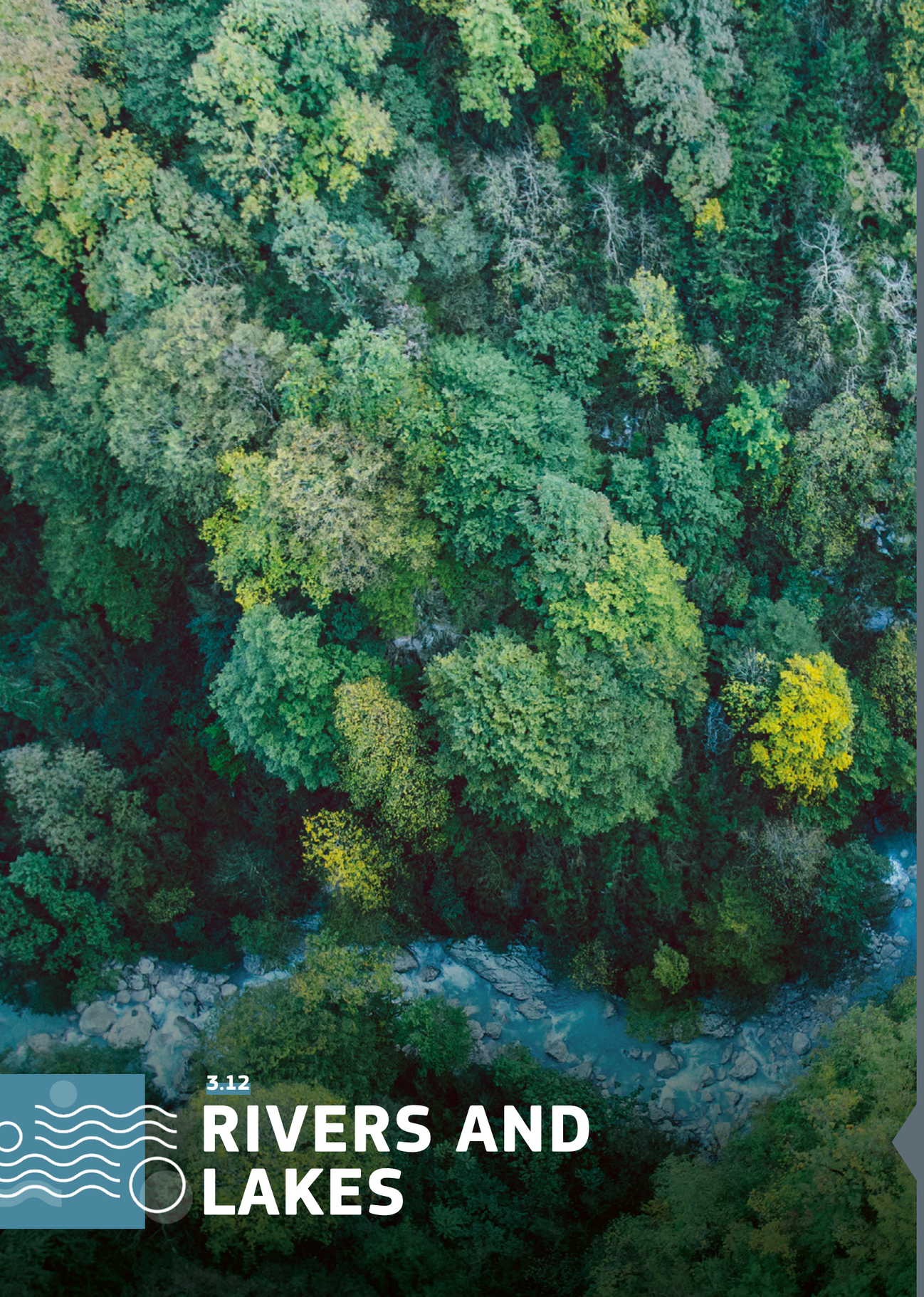
- *Decreasing emissions of air pollutants result in better air quality*

***Reasons for concern:***

- *Unsustainable land use in urban areas leads to losses in green spaces inside cities and fertile*
- *Agricultural land around cities*

***Legend***

Ecosystem improvement | Positive trend but sustainable level not reached | Ecosystem degradation



3.12

# RIVERS AND LAKES

## MAIN FINDINGS

Today, rivers and lakes have, on average, a better water quality than a decade ago: the concentration of nitrogen and phosphorus has decreased. However, the impact of improved water quality on the ecological status of rivers and lakes is not visible yet. This suggests that further reductions and additional measures are needed.

Some pressures have worsened or they are projected to increase. Riparian land, critical for aquatic ecosystems and ecosystem services, is lost to artificial land. Hydromorphological alterations, chemicals, invasive alien species and climate change affect aquatic habitats. While these latter trends could not be quantified in the first ecosystem assessment, these pressures are likely to be worsening.

Strengthening synergies between the Water Framework Directive and nature legislation can generate spin-off benefits for improving freshwater habitats and the delivery of regulating ecosystem services.

Rivers and lakes link land to the sea, transporting water, materials and biota across systems. Land-based anthropogenic pressures affect natural water availability and quality, modify riparian habitats, and alter the abundance and composition of aquatic biota.

Since 2000, domestic pollution and nitrogen atmospheric deposition to rivers and lakes have declined. Conversely, emissions from agricultural land are still high, invasive alien species are widespread, and land take in riparian zones and floodplains continues. This is undermining the capacity of natural riparian areas to deliver critical ecosystem services such as water purification, flood attenuation, erosion control, habitat provision, and surface-ground water connectivity.

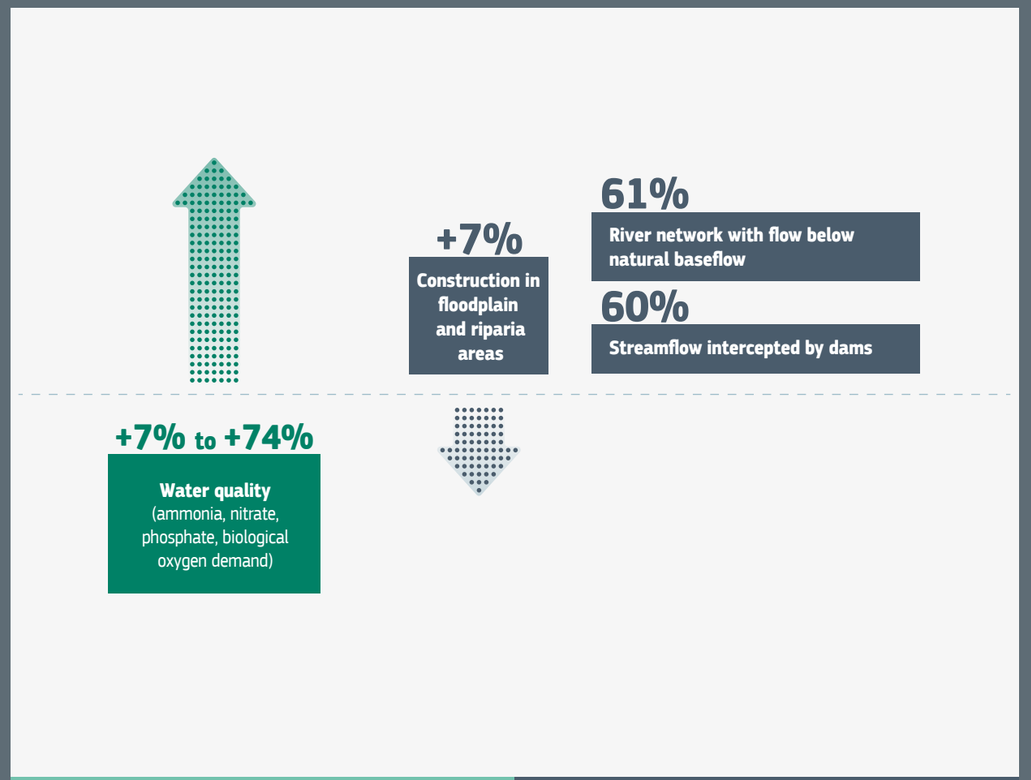
The Water Framework Directive (WFD) provides a comprehensive framework for monitoring pressures and the ecological status of rivers and lakes. Currently, 39% of rivers and lakes are in good or high ecological status, 38% in moderate, 17% in poor or bad status, and the status of 5% is unknown. While some condition indicators show improvements (notably water quality), trajectories of several indicators are unchanged or unresolved.

Strengthening synergies between the Water Framework Directive and nature legislation, for instance by investing in the recovery of riparian habitats, has been shown to generate positive spin-off benefits for enhancing freshwater habitats and improving delivery of regulating ecosystem services.



# Long-term trend in rivers and lakes

*% change of key indicators over 10 years*




***Progress:***

- *Water quality is improving*

***Reasons for concern:***

- *Poor river network connectity and reduction of the river-floodplain dynamics due to unsustainable land use*

***Legend***

Ecosystem improvement | Positive trend but sustainable level not reached | Ecosystem degradation

3.13

# MARINE ECOSYSTEMS

Marine ecosystems are subject to significantly increasing trends in anthropogenic pressures with major adverse impacts. Some pressure trends are decreasing or stable, but still remaining at unsustainably high levels. Marine and coastal ecosystems and their services are under severe pressures.

There are still huge knowledge gaps in the marine environment that need to be filled.

The large majority of marine protected areas (MPAs) are designated near the shore. Coverage decreases drastically with increasing distance from the coastline and depth. The number of marine species and habitats of European interest protected under the Habitats Directive is very limited. Connectivity and ecological coherence are also far from optimal. Most MPAs do not benefit from management plans and/or sufficient protection measures.

The challenges of climate change and continued biodiversity loss call for an in-depth rethinking of the model of protecting and restoring marine ecosystems. The United Nations *Decade of Ocean Science for Sustainable Development (2021-2030)*[10] can boost activities to support the sustainable development of the European seas.

*10 https://oceandecade.org/*

Europe's seas and oceans are hotspots of global biodiversity and provide our citizens with a flow of essential goods and services. However, decades of overfishing, discharges of nutrients, contaminants and litter have severely degraded the condition of marine ecosystems. Climate change is an additional pressure, with more and more measurable impacts.

Long-term trends in pressures from fishing are decreasing in the North East Atlantic Ocean and Baltic Sea and stable in the Mediterranean Sea and Black Sea. Some of the assessed commercial fish stocks show signs of recovery in the North East Atlantic Ocean and Baltic Sea, while they remain critically overfished in the Mediterranean Sea and the Black Sea.

Trends in the discharge of nutrients to some marine regions are generally decreasing.

All four marine regions suffer from pollution. Pressures from litter are difficult to assess reliably, as data availability seems to cover mostly beach litter, while pressures and impacts from seafloor litter and micro-litter are still largely unknown.

The spatial extent of marine protected areas has been steadily increasing in the past few years, exceeding the Aichi target 11 under the Convention for Biological Diversity. However, shortcomings can be found in the habitat coverage of the protected areas network. A further major caveat relates to the lack of data series that are too short to derive significant trends. This points to a need for further efforts on data collection and management at the EU scale.



# Long-term trend in marine ecosystems

*% change of key indicators over 10 years*


***Progress:***
- *Increase in marine protected areas*
- *Sustainable fishery*

***Reasons for concern:***
- *Climate change leads to acidification and warming of seas and oceans*
- *Data gaps for many key variables*

***Legend***

Ecosystem improvement | Positive trend but sustainable level not reached | Ecosystem degradation


3.14

# SOIL

Soil is a cross-cutting ecosystem: life in all terrestrial ecosystems depends on healthy soils. Soils are fragile and non-renewable within a human lifespan. The importance of healthy soils is generally under-recognized by society as a whole.

The increasing demand for land for urban development and infrastructure continues to destroy this critical ecosystem. In parallel, soils are under pressure from intensive agriculture and forestry practices, industrial pollution, and increasingly from climate change. Declines in soil condition are the likely consequence of all of the above drivers, acting individually or in combination.

Soil is lacking legal protection and a comprehensive EU monitoring framework. This has resulted in a very fragmented assessment of soil condition in the EU.

**Terrestrial ecosystems are in good condition if their soil is in good condition.** Therefore, special attention in the assessment goes to the inclusion of indicators which assess the condition of soils for all land related ecosystems.

Soils are estimated to cover 4,153,047 km$^2$ of the EU's terrestrial ecosystems (or 94.4%). Organic soils, including peatlands, account for around 6.5% of the soil area. The remaining 93.5% are mineral soils. Soils are under pressure from urban expansion (soil sealing resulting in complete destruction and loss of functions), intensive agriculture (resulting in compaction, loss of organic matter, loss of biodiversity, contamination, and unsustainable soil erosion) and industrial pollution (from both local and diffuse sources).

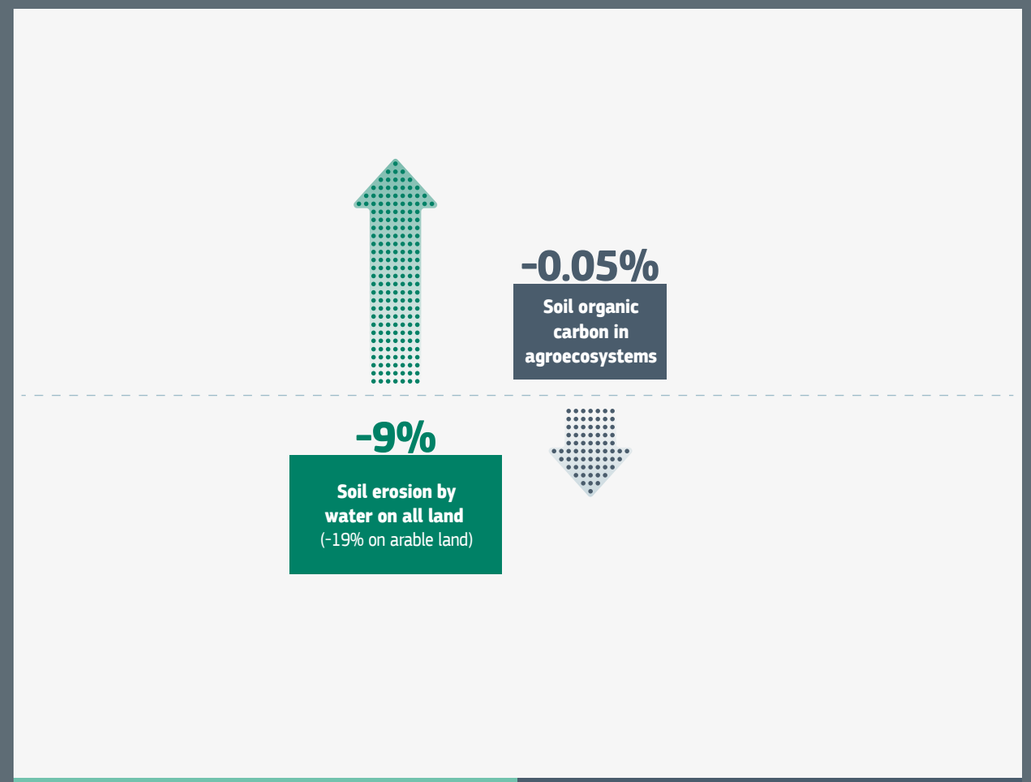
Short-term soil erosion rates showed a limited decrease of 0.4% in all ecosystems and 0.8% in arable lands in 2016 compared to 2010. Long-term trends indicate a stronger decrease in soil erosion by water, falling by 9% in all ecosystems and 19% on arable land (driven largely by the implementation of erosion reduction measures under the common agricultural policy). However, soil erosion by water across the EU (2.45 tonne per ha per year) remains above scientifically accepted soil formation rates (between 1.4 and 2 tonne per ha per year), which means that the soil ecosystem will continue to degrade.

Soil organic carbon (SOC) is a cross-cutting ecosystem condition indicator. SOC is vital to diverse soil functions and ecosystem services and hence a key determinant for ecosystem condition. Mineral cropland soils exhibit the lowest soil carbon stocks of all ecosystem types, apart from artificial areas, and may already have reached a minimum equilibrium. Cropland and grassland soils exhibit a slight decrease in soil organic carbon stocks between 2009 and 2015 of about 0.06% and 0.04% respectively, but with marked regional differences.



# Long-term trend in soils

*% change of key indicators over 10 years*




***Progress:***
- *Soil erosion by water is decreasing*

***Reasons for concern:***
- *Soil erosion is higher than soil formation*
- *Soil organic carbon is being lost*

***Legend***

Ecosystem improvement | Positive trend but sustainable level not reached | Ecosystem degradation

3.15

# ECOSYSTEM SERVICES

MAIN FINDINGS

Our society is increasingly dependent on ecosystems and their services.

Provisioning services such as food and timber provision are prioritised in our socio-economic system. In contrast, regulating and cultural ecosystem services have not been adequately valued or taken into account in policy and management decisions. This has resulted in the decline of ecosystem services and benefits such as access to nature, pollination of crops and wild plants, flood control, or carbon sequestration to mitigate climate change.

About 54% of the societal demand for regulating and cultural ecosystem services is insufficiently covered, showing an important ecosystem deficit. In other words, people want more ecosystem services than ecosystems can supply.

Targeted ecosystem restoration is needed, in particular in places where people need ecosystems for protection against floods, pollination, or recreation, in order to cope with the increasing societal demand and with the ecosystem deficit.

## KEY FACTS

Six ecosystem services were assessed for the period between 2000 and 2012: (i) crop provision, (ii) timber provision, (iii) carbon sequestration, (iv) crop pollination, (v) flood control and (vi) nature-based recreation. The analysis of the indicators for these services at EU level shows opposing trends in the ecosystem service potential and in the societal demand for these services. In other words, the demand and reliance of our society on these ecosystem services have increased, whereas ecosystems at EU level have not been enhanced to provide a higher quantity of these services. The amount of these services that ecosystems can offer has been decreasing, or has remained stable.

About 54% of the demand for regulating and cultural ecosystem services was not sufficiently covered by ecosystems (unmet demand, or ecosystem deficit). For instance, the demand for pollination set by farmers when they decide to grow pollinator-dependent crops is greater than the potential of ecosystems to host pollinator populations that can meet this demand.

This assessment highlights the need to enhance in particular regulating and cultural ecosystem services to cope with the increasing societal demand, narrowing the gaps between the needs for ecosystem services and what ecosystem effectively provide (supply). Regulating services in particular depend on healthy ecosystems, making a strong case for ecosystem restoration. The unmet demand for ecosystem services is a useful concept for the planning of restoration measures targeting the enhancement of ecosystem condition and capacity to deliver a wide and balanced range of ecosystem services.

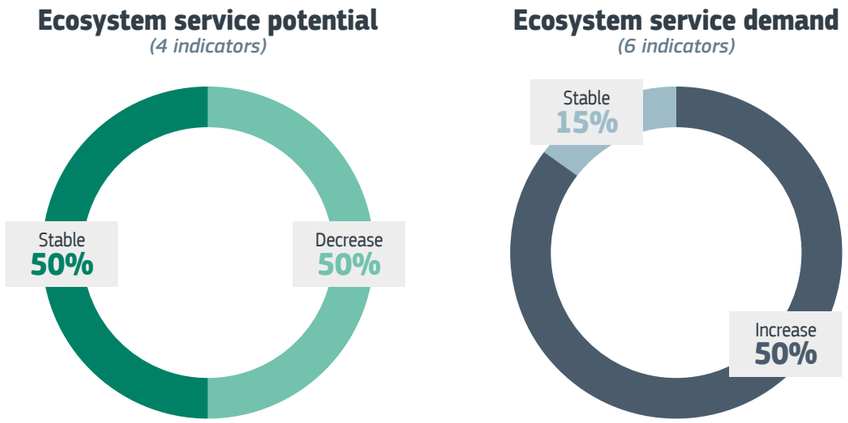



*Figure 10. Changes in ecosystem services (% change per 10 year).*

## BOX 1 SIX EU ECOSYSTEM SERVICES VALUED AT ALMOST €125 BILLION A YEAR

Based on 2012 data, the monetary value of six ecosystem services (crop provision, timber provision, climate regulation, flood control, crop pollination and nature-based recreation) was estimated to be worth €124.87 billion per year to the EU. Two-thirds of this estimated value is derived from regulating and cultural services. This value will further increase when adding more ecosystem services. The assessment was part of the INCA project that aims to develop a set of ecosystem accounts at EU level.

More info: *https://ec.europa.eu/jrc/en/science-update/eu-ecosystem-services-valued-almost-125-billion-year*

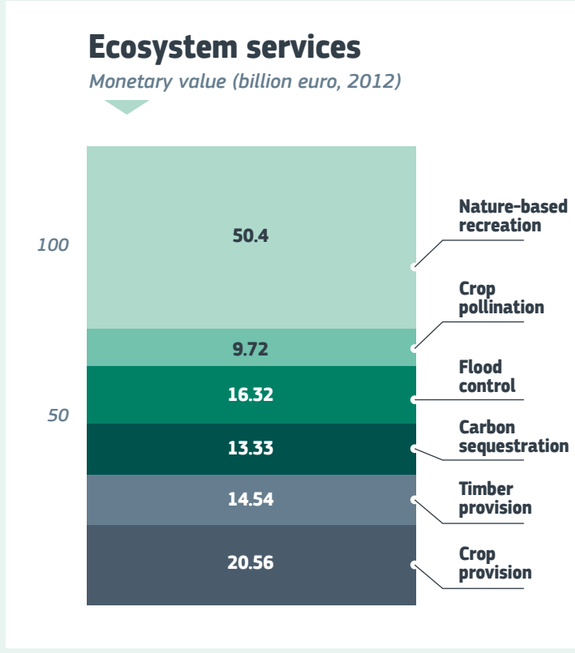



*Figure 11. Annual aggregated value for six ecosystem services*

## BOX 2 THE EU'S PATHWAY TO CARBON NEUTRALITY BY 2050 DEPENDS ON CONSERVING AND RESTORING ECOSYSTEMS

Carbon neutrality is achieved when there is a balance between emitting carbon and absorbing carbon from the atmosphere in carbon sinks. Removing carbon dioxide from the atmosphere is known as carbon sequestration and then storing it in soil and biomass is known as carbon storage. In order to achieve net zero anthropogenic or fossil fuel emissions, greenhouse gas emissions will have to be counterbalanced by carbon sequestration and storage. If managed well, ecosystems, in particular wetlands and marine ecosystems, are carbon sinks. Thus conserving ecosystems and maintaining their carbon stocks as well as enhancing ecosystem restoration to increase the capacity for carbon uptake from the atmosphere are essential solutions to reach carbon neutrality by 2050.

Source of the data: *https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:52020DC0562*

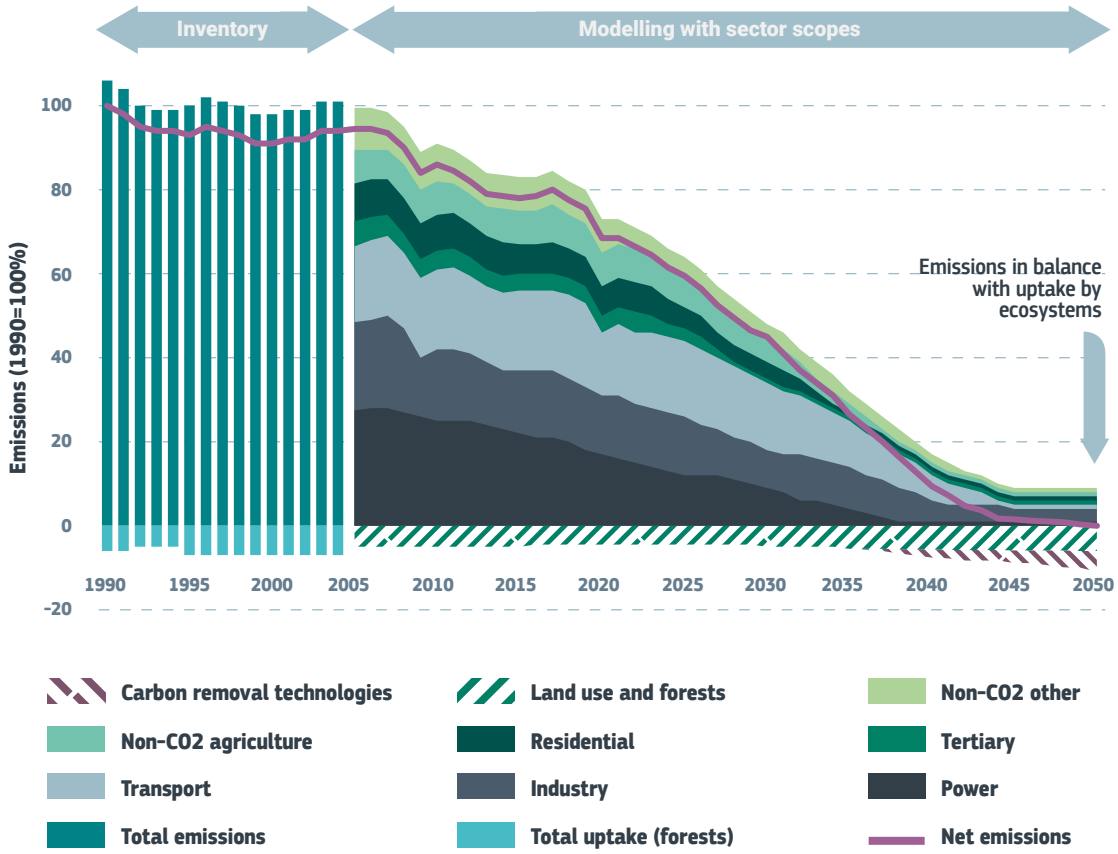



*Figure 12. The EU's pathway to climate neutrality, 1990-2050*

# KNOWLEDGE AND DATA NEEDS

4.

A scientific assessment relies on the current state of knowledge and data. This assessment has demonstrated that:

- Knowledge and data on ecosystems and their services have improved significantly, providing substantial evidence for the identification of key trends and for drawing of a number of policy-relevant conclusions.
- At the same time, the analysis has identified some major knowledge gaps and data needs, to be addressed in order to fully assess the state of Europe's ecosystems and to better understand and manage human impacts on ecosystem condition and the delivery of ecosystem services.

## KEY KNOWLEDGE NEEDS WERE IDENTIFIED IN RELATION TO THE FOLLOWING POLICY-RELEVANT QUESTIONS:

- What are the criteria to decide that an ecosystem is in a good condition or restored? How should **reference conditions** be defined so that the actual condition of ecosystems can be compared with a reference? Are there trade-offs between achieving a good ecosystem condition and essential human uses and activities in managed ecosystems? What is the role of science, stakeholders, landowners and policymakers in defining reference conditions?
- How will **climate change** impact the interaction between pressures, ecosystem condition and ecosystem services? How will it impact the spread of invasive alien species and other pressures on ecosystems? How will ecosystem services change under increasing climate change impacts? Can we measure the resilience of ecosystems to cope with these multiple pressures?
- In the context of increasing the overall **sustainability of the food system**, how can science identify strategic choices in agricultural land management that minimise trade-offs between biodiversity, ecosystem services and food production while ensuring a flourishing agricultural sector?
- What are the **carbon fluxes** between ecosystems and the atmosphere? Is the condition of ecosystems an important determinant of these fluxes? How can restoration of degraded ecosystems ensure that ecosystems are carbon sinks? What are likely trade-offs to consider?
- What is the **awareness** of the social, economic, ecological and cultural values of ecosystems, and their crucial importance to build societal resilience in the fight against climate change? How can scientists better communicate research to policymakers and the public? What knowledge needs to be communicated to boost ecosystem restoration and conservation?

## KEY DATA NEEDS

The EU ecosystem assessment is based on 132 unique pressure and ecosystem condition indicators. However, only two indicators, birds and butterflies, report in a consistent and harmonised way the trends on species diversity at the European scale. These two indicators are provided by non-governmental organisations. The low number of species-based EU-level indicators is striking in the context of the big data revolution that is ongoing also in the field of biodiversity. Increasingly, species data are recorded in the Global Biodiversity Information Facility (GBIF) or biodiversity observation platforms through citizen science. New technologies based on molecular methods or earth observation are generating massive amounts of biodiversity data. Yet, the uptake of such data for policy and management is hampered by temporal, spatial and taxonomic gaps, lack of standardisation and integration, quality constraints, limited availability of data in publicly accessible databases, little interoperability among data and infrastructures, and few suitable knowledge products readily usable for policy and management. This needs to change. **If biodiversity is becoming more central to EU strategic policies such as the European Green Deal, an EU framework for monitoring for biodiversity and ecosystems needs to be designed and become operational before the end of this decade.**

While our **knowledge of marine ecosystems** has improved, data coverage in space and time is still insufficient to provide a consistent picture across European marine regions and further analyses are needed for an exhaustive assessment of the condition of marine ecosystems. The *UN decade of ocean sciences for sustainable development*[11] aims to address this gap.

The following important initiatives will strengthen the EU's capacity to collect and disseminate biodiversity data for policymaking:

- *EuropaBON*[12] is a Horizon 2020 project that will design by 2023 an EU biodiversity monitoring network.
- The EU pollinators initiative, a policy to tackle the loss of pollinating insects, has proposed the *EU-PoMS*[13], the European pollinator monitoring network. This proposal will now be tested and rolled out in EU countries.
- The *Knowledge Centre for Biodiversity*[14] and the Horizon Europe Science Service on biodiversity will strengthen biodiversity science and uptake in the EU policymaking processes. The JRC is hosting different other biodiversity-relevant *knowledge and competence centres*[15] such as the *EU Soil Observatory*[16], and the EU Observatory on Deforestation & Forest degradation.
- A new initiative on Ocean Observation including the reinforcement on the collection of data, using fishing boats to collect environmental data.

These initiatives add to an already rich landscape of projects, initiatives and policies on biodiversity. The most comprehensive source of biodiversity data for Europe is BISE: *https://biodiversity.europa.eu/*


*Figure 13. Data gaps revealed by the EU Ecosystem Assessment and solutions for closing the gaps.*

*11 https://www.oceandecade.org/*

*12 https://europabon.org/*

*13 https://publications.jrc.ec.europa.eu/repository/handle/JRC122225*

*14 https://knowledge4policy.ec.europa.eu/biodiversity_en*

*15 https://ec.europa.eu/jrc/en/knowledge*

*16 https://ec.europa.eu/jrc/en/eu-soil-observatory*

# 5. RESTORING ECOSYSTEMS

**This EU ecosystem assessment reveals that ecosystem condition across all EU ecosystem types needs to improve significantly in order to halt and reverse biodiversity loss, safeguard essential ecosystem services for human wellbeing and support climate change mitigation and adaptation.**

**More efforts are needed to bend the curve of biodiversity loss and ecosystem degradation and to put ecosystems on a recovery path.** This includes first and foremost reducing key pressures to acceptable levels. Progress made in certain areas such as pollution reduction, the increased share of organic farming, the expansion of forests, and the efforts to maintain marine fish stocks at sustainable levels shows that a persistent implementation of policies can bring results on the ground. These successes should encourage us to act now and to put forward an ambitious plan for the restoration of Europe's ecosystems.

## NEXT STEPS FOR SCIENCE SUPPORT IN DEFINING RESTORATION TARGETS

The EU ecosystem assessment used 2010 as a baseline against which changes in pressures and ecosystem condition are evaluated. However, **subsequent work is needed to set a reference condition to compare the past, current or future condition of ecosystems and to decide on favourable target values.** Such analysis should ideally be based on a minimum set of key indicators which capture the full breadth of ecosystem condition and which can be used to monitor ecosystems over time. It also requires a scientifically robust aggregation scheme or a framework for aggregating different indicators into a single conclusion about the condition of ecosystems.

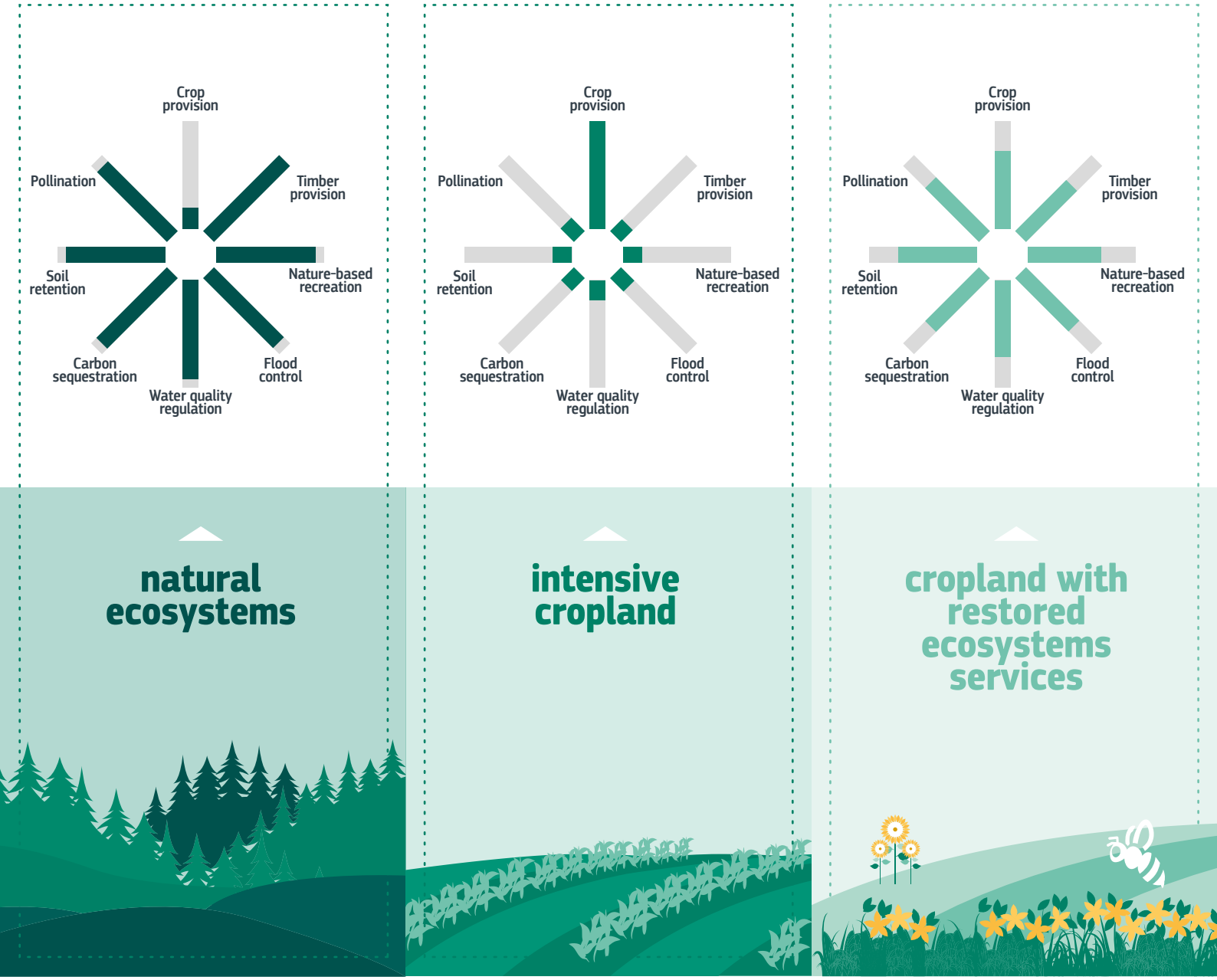
The capacity of the EU to **monitor biodiversity and ecosystems needs to be enhanced**. A better biodiversity and ecosystem monitoring system is essential not only to support possible legislation on ecosystem restoration but also to help implement existing legislation and better coordinate and steer actions that are dependent on knowledge about key biodiversity and ecosystem parameters.

Increased monitoring of biodiversity and ecosystems requires an updated data infrastructure that allows access to a wide variety of information sources regularly updated on pressures, biodiversity, ecosystem condition and ecosystem services. An international framework for organising ecosystem data was adopted in March 2021 and it can be used as a standard within the EU. The System of Environmental Economic-Accounting – Ecosystem Accounting defines an integrated statistical framework for organising biophysical data, tracking changes in ecosystems, their condition and services and linking this information to economic and other human activities. This standard, which is relevant for both public and corporate accounting systems for facilitating sustainable investments, is essential to mainstream biodiversity and ecosystems in the reference scenarios as well as for models used for policy and decision-making on climate, agriculture, energy, or transport.

**Infographic: Why restoring ecosystems is important for nature and people.** Conceptual framework for comparing land use and trade-offs of ecosystem services. The provisioning of multiple ecosystem services under different land-use regimes can be illustrated with these simple "flower" diagrams, in which the condition of each ecosystem service is indicated along each axis. (In this qualitative illustration, the axes are not labelled or normalized with common units.) For purposes of illustration, we compare three hypothetical landscapes: a natural ecosystem (left), an intensively managed cropland (middle), and a cropland with restored ecosystem services (right). The natural ecosystems are able to support many ecosystem services at high levels, but not food production. The intensively managed cropland, however, is able to produce food in abundance (at least in the short run), at the cost of diminishing other ecosystem services. However, a middle ground—a cropland that is explicitly managed to maintain other ecosystem services—may be able to support a broader portfolio of ecosystem services.

INFOGRAPHIC

# CONCEPTUAL FRAMEWORK FOR COMPARING LAND USE AND TRADE-OFFS OF ECOSYSTEM SERVICES




*Jonathan A. Foley et al. Science 2005;309:570-574*

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**Annex with indicator fact sheets:**

*Maes, J., Teller, A., Erhard, M., Condé, S., Vallecillo, S., Barredo, J.I., Paracchini, M.L., Abdul Malak, D., Trombetti, M., Vigiak, O., Zulian, G., Addamo, A.M., Grizzetti, B., Somma, F., Hagyo, A., Vogt, P., Polce, C., Jones, A., Marin, A.I., Ivits, E., Mauri, A., Rega, C., Czúcz, B., Ceccherini, G., Pisoni, E., Ceglar, A., De Palma, P., Cerrani, I., Meroni, M., Caudullo, G., Lugato, E., Vogt, J.V., Spinoni, J., Cammalleri, C., Bastrup-Birk, A., San Miguel, J., San Román, S., Kristensen, P., Christiansen, T., Zal, N., de Roo, A., Cardoso, A.C., Pistocchi, A., Del Barrio Alvarellos, I., Tsiamis, K., Gervasini, E., Deriu, I., La Notte, A., Abad Viñas, R., Vizzarri, M., Camia, A., Robert, N., Kakoulaki, G., Garcia Bendito, E., Panagos, P., Ballabio, C., Scarpa, S., Montanarella, L., Orgiazzi, A., Fernandez Ugalde, O., Santos-Martín, F., Mapping and Assessment of Ecosystems and their Services: An EU ecosystem assessment - supplement, EUR 30161 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-22954-4, doi:10.2760/519233, JRC120383*

Weblink of the Scientific report: ***https://publications.jrc.ec.europa.eu/repository/handle/JRC120383***

The activities of the working group MAES and the five MAES reports can be consulted at the ***website***[17] of the European Commission and on ***ecosystems page***[18] of BISE, the Biodiversity Information System for Europe.

# ANNEX 1

## HOW THE EU AND THE MEMBER STATES JOINTLY CREATED A KNOWLEDGE BASE ON ECOSYSTEMS TO SUPPORT EU AND NATIONAL BIODIVERSITY POLICIES

Action 5 of the *EU Biodiversity Strategy to 2020*[19] asked the Member States to map and assess the state of ecosystems and their services, with the assistance of the Commission. Action 5 was overseen by the working group on Mapping and Assessment of Ecosystems and their Services (MAES). The working group, with experts and stakeholders from member states, the European Commission and the European Environment Agency, and the research community, produced between 2012 and 2020 *a coherent analytical framework*[20] for mapping ecosystems and assessing ecosystem condition and ecosystem services. This framework includes typologies for ecosystems, and indicators for ecosystem condition and ecosystem services, guidance on mapping, stakeholder engagement, and natural capital accounting.

### KEY OUTCOMES OF MAES

- Action 5 and MAES have been instrumental in generating, boosting, scaling up and harmonising mapping and assessment activities at national and regional scale (see the MAES *ESMERALDA*[21] barometer). Most EU countries have set up national projects on mapping and assessment and have taken the necessary steps to engage stakeholders and policymakers. Several countries have online data repositories with ecosystem data.
- A solid MAES community is established across member states, thanks to the efforts of MESEU, TRAIN and ESMERALDA, research projects that engaged policymakers, researchers and ecosystem practitioners through workshops, common mapping sessions, and trainings. A synthesis of all the work can be consulted online: *http://www.maes-explorer.eu/*
- *MOVE*[22] and MOVEON go beyond Europe's seas and transfers knowledge to the outermost regions and overseas countries and territories of Europe.



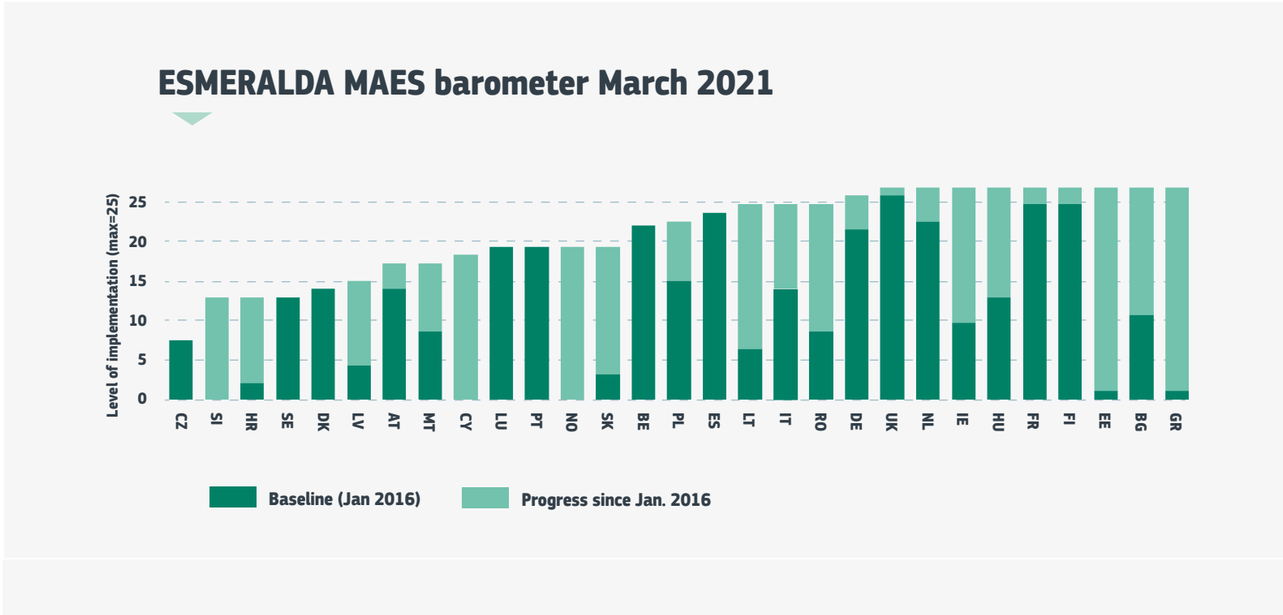


*Figure 14. Measuring successful implementation of MAES in the 27 EU member states, Norway and the UK. The barometer measures implementation of MAES based on a set of 25 yes/no questions that survey the progress made in policy integration and research. A baseline was set in January 2016 and since then the progress has been measured every six months until March 2021.*

17 https://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/index_en.htm

18 https://biodiversity.europa.eu/ecosystems

19 https://ec.europa.eu/environment/nature/biodiversity/strategy_2020/index_en.htm

20 https://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/index_en.htm

21 https://oneecosystem.pensoft.net/article/29153/

22 https://moveproject.eu/

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