biodiversa+
European Biodiversity Partnership

EUROPEAN PARTNERSHIP

Getting restoration right together

A foundational digest on the Nature Restoration Regulation

Co-funded by
the European Union

Document Information

Grant Agreement number	101052342
Project acronym	Biodiversa+
Project full name	The European Biodiversity Partnership
Biodiversa+ duration	7 years
Biodiversa+ start date	Start date: 1st October 2021
For more information about Biodiversa+	Website: http://www.biodiversa.eu/ Email: contact@biodiversa.eu LinkedIn: Biodiversa+

Produced under	BiodivRestore Knowledge Hub
Deliverable title	Getting restoration right together: A foundational digest on the Nature Restoration Regulation
Dissemination level	Public
Authors	Rachel KRISTENSEN, Franziska WENSKUS
Contributors	Vito Emanuele CAMBRIA, Magda BOU DAGHER KHARRAT, Rik DE VREESE, Cloé DURIEUX, Erika FABBRIZZI, Laura GUIMARAES, Thomas JUNG, Agnieszka JÓZEFOWSKA, Tuula LARMOLA, Josep LLORET, Laura PUÉRTOLAS, Metodi SOTIROV, Katalin TOROK, Elena VELADO ALONSO, Tom WILD
Date of publication	September 2026
Disclaimer	Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them. This deliverable may not have been approved yet by the European Commission and may be subject to change.

Cover page illustration: Photo by Lauri Poldre (Pexels)

What is Biodiversa+

The European Biodiversity Partnership, Biodiversa+, supports excellent biodiversity research with impact for policy and society. Connecting science, policy and practice for transformative change, Biodiversa+ is part of the European Biodiversity Strategy for 2030, which aims to put Europe's biodiversity on a path to recovery by 2030. Co-funded by the European Commission, Biodiversa+ brings together partners from research funding, research programming and environmental policy across European and associated countries to work on five main objectives:

- Plan and support research and innovation on biodiversity through a shared strategy, annual joint calls for research projects, and capacity building activities.
- Set up a network of harmonised schemes to improve monitoring of biodiversity and ecosystem services across Europe.
- Contribute high-end knowledge for deploying Nature-based Solutions and valuing biodiversity in the private sector.
- Ensure efficient science-based support for policy-making and implementation in Europe.
- Strengthen the relevance and impact of pan-European research on biodiversity in a global context.

More information: https://www.biodiversa.eu/

Table of contents

A user-friendly digest of the Nature Restoration Regulation (NRR), bringing together key NRR objectives, obligations and targets with restoration DO's and DON'Ts, ecosystem-specific guidance and practical decision support for developing and reviewing National Restoration Plans and for planning, implementing, monitoring and managing restoration under the NRR at national, regional and local levels.

WHY AND TO WHOM

The Nature Restoration Regulation (NRR) complements and reinforces existing EU and international environmental commitments and objectives for long-term nature recovery, quality and sustainability. These include the European Green Deal, the EU Biodiversity Strategy for 2030, the Convention on Biological Diversity, the Kunming-Montreal Global Biodiversity Framework (Targets 1, 2 and 11), the UN 2030 Agenda Sustainable Development Goals (6.3, 6.6, 14.1, 14.2, 15.1, 15.2 and 15.3), and the UN General Assembly's designation of 2021–2030 as the UN Decade on Ecosystem Restoration.

Why this document exists

The NRR brings together a range of legal requirements, definitions and targets that can be challenging to interpret and translate into practical restoration action. This need was reflected throughout the Biodiversa+ Knowledge Hub's expert discussions, conferences, dialogue events and engagement with the European Commission and Member State representatives. As implementation moves towards restoration at an unprecedented scale, experts highlighted the importance of mitigating risks associated with large-scale restoration, learning from existing restoration experience and bringing together scientific knowledge, practical experience and best practice to support implementation at this early stage.

This document provides a practical interpretation of the NRR, linking its requirements with restoration principles, scientific knowledge and experience from restoration practice. It is intended as a user-friendly reference for restoration and policy practitioners, bringing together the NRR's key objectives, obligations and targets with restoration DO's and DON'Ts, ecosystem-specific guidance and practical decision support. In doing so, it provides a quick reference to support the development and review of National Restoration Plans (NRPs), as well as the planning, implementation, monitoring and management of restoration at local, regional and national levels.

Implementation of the NRR requires each Member State to prepare a National Restoration Plan (NRP), setting out how the Regulation's targets and obligations will be addressed. Draft NRPs are to be submitted by 1 September 2026, with final plans expected by 1 September 2027. The first plans must set out restoration measures contributing to the NRR's 2030 targets, including the requirement to cover at least 20% of the EU's land and sea areas with restoration measures, while setting out the pathway towards restoring all ecosystems in need of restoration by 2050.

The development of the NRPs presents a number of practical and scientific challenges. These include establishing reliable baselines, defining favourable reference areas, determining appropriate restoration measures and setting targets for biodiversity recovery and ecosystem functioning. Recent dialogue with

Member States has also highlighted challenges associated with data availability, monitoring, scientific and technical capacity, stakeholder engagement, coordination and financing.

At the same time, restoration is already taking place across Europe through projects led or commissioned by a wide range of actors, including public authorities, land managers, private landowners and Non Government Organisations. The challenge is therefore not only to determine where and how much restoration is required, but also to ensure that restoration measures are designed and implemented in ways that support ecological recovery over time.

Restoration outcomes depend on the quality of the process used to plan, implement and evaluate them. Limited baseline information, insufficient ecological expertise, time and resource constraints, pressure for rapid results, and inadequate consideration of degradation pressures can all affect restoration outcomes. These constraints can lead to approaches that improve individual components of a site without restoring the ecological processes and functions required for longer-term recovery.

For this reason, the document identifies key restoration DO's and DON'Ts that apply across ecosystems. These include addressing the pressures causing degradation, considering restoration at an appropriate ecological scale, restoring ecosystem structure and function, establishing clear baselines and success criteria, using appropriate restoration materials, engaging relevant stakeholders and incorporating monitoring, maintenance and adaptive management throughout the restoration process.

Restoration should therefore be understood as an iterative process rather than a one-off intervention. Planning, implementation, monitoring, evaluation and ongoing management need to be connected so that restoration measures can be assessed against defined objectives and adjusted where necessary. This approach is consistent with the practical restoration process presented in Getting Restoration Right Together, where adaptive management is considered from the outset and monitoring is used to inform subsequent action.

What this document offers

This document draws on the expertise and project results of the BiodivRestore Knowledge Hub[1] to provide a practical digest of the key components of the NRR and the restoration principles that support effective implementation.

It brings together the NRR's key objectives, obligations and targets with restoration DO's and DON'Ts, ecosystem-specific guidance, examples from restoration practice and a practical decision tool. Together, these elements are intended to help translate the requirements of the NRR so they can be better incorporated into restoration planning and action and facilitate the successful implementation of the NRR.

[1] BiodivRestore Knowledge Hub is a pan-European network of experts established by Biodiversa+ to connect scientific research with the practical implementation of ecosystem restoration and the NRR. This document was developed by the Implementation Taskforce which is focused on making restoration knowledge useful for implementation. Its remit includes strengthening the knowledge base for restoration targets, developing science-based guidance, supporting capacity building and helping address implementation needs.

Who is it for

The primary audience is restoration managers and other professionals responsible for initiating, overseeing, coordinating and managing restoration projects at local, regional and national levels. It is also relevant to those in the Member States who are involved in developing, implementing or reviewing National Restoration Plans, and to scientific and technical experts, land managers and other stakeholders contributing to restoration planning and delivery.

The document provides a simple and practical interpretation of the NRR, while recognising that restoration approaches need to be adapted to the ecological and socio-economic context of each site or landscape. It therefore combines principles that apply across restoration activities with ecosystem-specific guidance for the ecosystems addressed by the NRR.

The document takes the reader on a journey from the fundamentals of the NRR, through a practical decision tool for planning, implementing, monitoring and managing restoration, to the key restoration DO's and DON'Ts and factsheets on relevant NRR articles. Its aim is to support a more consistent, science-based approach to the implementation of the NRR and to the development, implementation and review of National Restoration Plans.

THE NATURE RESTORATION REGULATION MUST-KNOWS

Purpose of this section

This section provides a structured, practical overview of the EU Nature Restoration Regulation. It is intended to support readers in understanding the NRR's basic objectives, obligations, timelines, and implementation requirements, including the preparation/ review of National Restoration Plans (NRPs).

1. What is the Nature Restoration Regulation?

1.1 Overview

The Nature Restoration Regulation is a binding EU Regulation adopted under Article 192(1) of the Treaty on the Functioning of the European Union. It establishes legally binding restoration targets and obligations to ensure the long-term recovery of biodiverse and resilient ecosystems across the EU's land and sea areas.

The Regulation introduces ecosystem, habitat, and species-specific restoration requirements covering, among others:

- Terrestrial, freshwater, coastal, and marine ecosystems
- Urban ecosystems
- Agricultural and forest ecosystems
- Pollinators
- Free-flowing rivers and floodplains

As a Regulation, the NRR is directly applicable in all Member States without the need for national transposition.

1.2 Timeline for implementation

- Entry into force: 2024
- By 2030:
    - Restore at least 20% of EU land and sea areas
    - Meet first-stage habitat and ecosystem-specific targets
    - Reverse the decline of pollinator populations
    - No net loss of urban green space and tree canopy
- By 2040: Intermediate restoration milestones for most ecosystems
- By 2050: All ecosystems in need of restoration are covered by effective measures

2. Why is the NRR significant?

The NRR is a cornerstone of EU environmental policy and contributes directly to:

- The European Green Deal

- The EU Biodiversity Strategy for 2030
- The Convention on Biological Diversity and the Kunming–Montreal Global Biodiversity Framework (notably Targets 1, 2, and 11)
- The UN Sustainable Development Goals (Sustainable Development Goals 14.2, 15.1, 15.2, 15.3)
- The UN Decade on Ecosystem Restoration (2021–2030)

It addresses the persistent decline in biodiversity by moving beyond protection alone and introducing legally binding restoration obligations at scale.

3. Regulation versus Directives: what is different?

Unlike previous EU environmental instruments such as the Habitats and Birds Directives, the NRR:

- Is directly applicable in all Member States
- Establishes clear, quantified, and time-bound restoration targets
- Requires active restoration, not only protection or maintenance
- Covers ecosystems beyond Natura 2000 sites

The Regulation was adopted in response to evidence that existing measures were insufficient to halt biodiversity loss and ecosystem degradation.

4. Why is the NRR needed?

Assessments such as the Commission's State of Nature in the EU Report (2020) and the Global Resources Outlook 2024 show that:

- A majority of protected habitats and species are in poor or bad condition
- Key drivers of degradation include intensive agriculture, forestry and fisheries, hydrological modification, urbanisation, pollution, invasive alien species, and climate change

The NRR responds to the triple planetary crisis of climate change, biodiversity loss, and pollution, and supports the transition towards sustainable and resilient socio-ecological systems.

5. Main components of the NRR

5.1 Preamble

The preamble sets out the scientific, legal, and policy rationale for the Regulation, emphasising synergies with climate action, disaster risk reduction, food security, and sustainable development.

5.2 General provisions and key definitions

Objectives:

- Restore degraded ecosystems across EU land and sea areas
- Contribute to climate mitigation and adaptation

- Enhance food security
- Fulfil international environmental commitments

EU-level targets:

- At least 20% of land and sea areas restored by 2030
- All ecosystems in need of restoration covered by measures by 2050

Key definitions:

- **Restoration:** 'restoration' means the process of actively or passively assisting the recovery of an ecosystem in order to improve its structure and functions, with the aim of conserving or enhancing biodiversity and ecosystem resilience, through improving an area of a habitat type to good condition, re-establishing favourable reference area, and improving a habitat of a species to sufficient quality and quantity in accordance with Article 4(1), (2) and (3) and Article 5(1), (2) and (3), and meeting the targets and fulfilling the obligations under Articles 8 to 12, including reaching satisfactory levels for the indicators referred to in Articles 8 to 12.

- **Good condition:** 'good condition' means, as regards an area of a habitat type, a state where the key characteristics of the habitat type, in particular its structure, functions and typical species or typical species composition reflect the high level of ecological integrity, stability and resilience necessary to ensure its long-term maintenance and thus contribute to reaching or maintaining favourable conservation status for a habitat, where the habitat type concerned is listed in Annex I to Directive 92/43/EEC, and, in marine ecosystems, contribute to achieving or maintaining good environmental status.

- **Satisfactory Levels:** by 2030, Member States shall set, through an open and effective process and assessment based on the latest scientific evidence, the guiding framework referred to in Article 20(10) and, if available, the guiding framework referred to in Article 20(11) satisfactory levels for: (a) pollinator populations referred to in Article 10(1) and for the indicator referred to in Article 12(2); (b) each of the chosen indicators referred to in Article 11(2); (c) each of the chosen indicators referred to in Article 12(3); (d) urban green space referred to in Article 8(2); and (e) urban tree canopy cover referred to in Article 8(3).

- **Favourable Reference Area:** 'favourable reference area' means the total area of a habitat type in a given biogeographical or marine region at national level that is considered the minimum necessary to ensure the long-term viability of the habitat type and its typical species or typical species composition, and all the significant ecological variations of that habitat type in its natural range, and which is composed of the current area of the habitat type and, if that area is not sufficient for the long-term viability of the habitat type and its typical species or typical species composition, the additional area necessary for the re-establishment of the habitat type; where the habitat type concerned is listed in Annex I to Directive 92/43/EEC, such re-establishment contributes to reaching favourable conservation status for a habitat and, in marine ecosystems, such re-establishment contributes to achieving or maintaining good environmental status.

- **Good Environmental Status:** 'good environmental status' means the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine

environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations, i.e.:

(a) the structure, functions and processes of the constituent marine ecosystems, together with the associated physiographic, geographic, geological and climatic factors, allow those ecosystems to function fully and to maintain their resilience to human-induced environmental change. Marine species and habitats are protected, human-induced decline of biodiversity is prevented and diverse biological components function in balance;

(b) hydro-morphological, physical and chemical properties of the ecosystems, including those properties which result from human activities in the area concerned, support the ecosystems as described above. Anthropogenic inputs of substances and energy, including noise, into the marine environment do not cause pollution effects;

Good environmental status shall be determined at the level of the marine region or subregion as referred to in Article 4, on the basis of the qualitative descriptors in Annex I. Adaptive management on the basis of the ecosystem approach shall be applied with the aim of attaining good environmental status.

5.3 Restoration targets and obligations (Articles 4–13)

Article 4 – Terrestrial, coastal, and freshwater ecosystems

- Restore habitats listed in Annex I that are not in good condition:
  - 30% by 2030
  - 60% by 2040
  - 90% by 2050
- Priority given to Natura 2000 sites until 2030

Article 5 – Marine ecosystems

- Progressive restoration targets for Annex II habitat groups
- Alignment with the Marine Strategy Framework Directive

Article 6 – Renewable energy

- Renewable energy projects are presumed to be in overriding public interest
- Exemptions possible subject to Strategic Environmental Assessment Directive or Environmental Impact Assessment Directive requirements

Article 8 – Urban ecosystems

- No net loss of urban green space and tree canopy by 2030
- Increasing trends thereafter until satisfactory levels are reached

Article 9 – Free-flowing rivers and floodplains

- Inventory of and removal of artificial barriers
- EU-wide objective of restoring at least 25,000 km of free-flowing rivers by 2030

Article 10 – Pollinators

- Reverse decline by 2030
- Achieve increasing population trends thereafter
- EU-wide standardised monitoring methodology

Article 11 – Agricultural ecosystems

- Improve biodiversity using national indicators
- Restore drained peatlands with defined rewetting targets
- Rewetting on agricultural land remains voluntary for landowners

Article 12 – Forest ecosystems

- Improve biodiversity using bird and forest structure indicators
- Flexibility for force majeure and climate-driven changes

Article 13 – Planting three billion trees

- Contribution to the EU-wide target by 2030
- Ecological principles, native species, and connectivity required

6. National Restoration Plans

6.1 Purpose

NRPs are the main implementation instruments through which Member States plan, coordinate, and deliver restoration measures.

6.2 Core requirements (Article 14)

NRPs must:

- Be based on the best available scientific evidence
- Quantify areas and ecosystems in need of restoration
- Map habitats, species needs, and urban ecosystem areas
- Identify restoration priorities and suitable areas
- Define monitoring frameworks and indicators
- Identify synergies with climate, agriculture, forestry, energy, water, and disaster risk policies
- Ensure public participation and transparency

6.3 Financing and support

- No obligation to reprogramme fund from the Common Agricultural Policy, Common Fisheries Policy or Multiannual Financial Framework
- Member States may establish public or private support schemes
- Incentives encouraged for farmers, foresters, and land managers

7. Cross-border cooperation

7.1 Legal basis

Member States shall, where possible, foster synergies with other NRPs, particularly:

- For transboundary ecosystems

- For shared marine regions or subregions

7.2 Practical implications

- Coordination of restoration objectives and measures
- Alignment of monitoring and data-sharing
- Use of existing regional cooperation structures

8. Monitoring and adaptive management

- Use harmonised EU methodologies where available
- Monitor progress at least every six years
- Apply adaptive management to respond to new knowledge, climate impacts, and socio-economic conditions

Note: It is relevant to take into consideration the Adaptive Management (AM) cycle within this legal framework. AM needs to be considered from the outset as the basis for restoration design, planning and implementation, enabling early monitoring and adjustment during the critical first 2–3 years. AM should not prescribe a fixed monitoring period, as this should be determined case-by-case based on the restoration objectives, indicators, and environmental context.

9. Exemptions

9.1 Renewable energy

Specific exemptions apply where projects are assessed under Strategic Environmental Assessment or Environmental Impact Assessment and meet overriding public interest criteria.

9.2 Defence

Activities essential for national defence may be exempt under defined conditions.

10. National Knowledge Hubs

Member States are encouraged to establish National Knowledge Hubs to:

- Support evidence-based planning and implementation
- Facilitate exchange between scientists, practitioners, and policymakers
- Promote best practices and innovation

Resource: https://www.biodiversa.eu/2024/08/13/guide-for-the-establishment-of-national-hubs/

KEY STEPS FOR IMPLEMENTING THE NATURE RESTORATION REGULATION

The following decision tree outlines the key steps when implementing the NRR and preparing/ reviewing the National Restoration Plans (NRPs). It is intended as a practical, sequential guide supporting compliance, strategic planning, education and adaptive management.

Overview

Detailed steps (1/3)

Scope, ecosystem type, condition, restoration need and targets

1 Determine scope and applicability

Does the area, ecosystem, habitat or species fall within the scope of the NRR (Articles 4-13)?

No → **NRR does not apply.** Consider other EU or national instruments.

Yes ↓

2 Identify ecosystem type

Which ecosystem category applies?

Terrestrial, coastal & freshwater habitats (Annex I)	→ Art. 4
Marine habitat (Annex II)	→ Art. 5
Urban ecosystem	→ Art. 8
River and floodplain connectivity	→ Art. 9
Pollinators	→ Art. 10
Agricultural ecosystem	→ Art. 11
Forest ecosystem	→ Art. 12
Tree planting contribution	→ Art. 13

Proceed to the relevant article-specific assessment ↓

3 Assess current condition

Is the ecosystem or habitat in good condition or at a satisfactory level?

Yes → **Apply non-deterioration and maintenance obligations.** Include in the monitoring framework (Step 11).

How to know? Check the latest applicable national Habitats / Birds Directive assessment. Use the Eionet collection as a starting point; ask the national environmental agency for more recent data.

No ↓

4 Quantify restoration need

Have the area and degree of degradation been quantified using the best available scientific evidence?

Yes, define:

- Total area
- Area not in good condition
- Favourable reference area (where applicable)
- Suitability under climate change scenarios

No → **Build the evidence base.** Carry out preparatory monitoring, mapping and research (Article 14).

How to know? Use Article 17 data for 2013-2018 or 2019-2024, or another scientifically credible source. Give area estimates or ranges in km² from the latest reporting. If unavailable, monitor under Habitats Directive Article 11.

Yes ↓

5 Check applicable targets and deadlines

Which legally binding targets apply?

- **2030** 20% land/sea; 30% habitat restoration; pollinator decline reversed; no net decline in urban green space or tree cover.
- **2040** 60% intermediate targets.
- **2050** 90%, or all ecosystems in need of restoration.

Align the timeframe and priority areas, including Natura 2000 until 2030.

Applicable targets identified: continue to Step 6 on the next page ↓

Detailed steps (2/3)

Exemptions, integration, design and engagement

Applicable targets identified

6 Identify constraints and exemptions

Are overriding public interests or exemptions involved?

- Renewable energy (Article 6; SEA / EIA required)
- Defence or national security interests
- Force majeure or unavoidable climate-driven change (forests).

Yes →

Apply exemption criteria.
Provide justification and document transparently.
Then continue to Step 7.

How to know: Consult national maps of areas needed for the 2030 renewable energy targets, renewable acceleration areas and areas in military use.

No / exemption check completed

7 Identify synergies and integration

Can the measures deliver multiple benefits?

- Climate mitigation and adaptation
- Disaster risk reduction
- Water management
- Sustainable agriculture or forestry
- Urban resilience.

Act →

Yes: prioritise measures delivering multiple benefits.

No: reassess alternatives where feasible.

Proceed with the selected measures.

How to know: Define a clear restoration rationale and target values. Identify overlaps with the rationale and targets of other policies or activities.

Continue

8 Select and design restoration measures

Have suitable measures been identified?

- Is passive restoration sufficient?
- Is active restoration required?
- Are Annex VII measures applicable?

Design →

Design measures to:

- Improve ecosystem structure and function
- Enhance connectivity
- Be climate-resilient
- Avoid significant harm to other objectives
- Use exclusively certified pathogen-free plant material
- Mitigate the key transversal risks

How to know: Use the report's *Getting restoration right* section and its *Transversal dos and don'ts in restoration* to guide planning and implementation.

Measures designed

9 Engage stakeholders

Have stakeholders been engaged early and effectively?

- Landowners, farmers, foresters, fishers
- Local and regional authorities
- Civil society and NGOs
- Scientific and technical experts.

No → ←

Conduct inclusive consultation (Directive 2001/42/EC).
Then repeat this check.

How to know: Evaluate the engagement strategy against Directive 2001/42/EC.

Yes: continue to Step 10 on the next page

Detailed steps (3/3)

Financing, monitoring and implementation

GETTING RESTORATION RIGHT

How to use

This chapter is structured into a section about transversal “DO’s” and “DON’Ts” common to all articles/ecosystems and sections specific to each ecosystem. Within each ecosystem factsheet, the information is organised by first stating the goal and target values specified in the NRR, before giving example measures on how to achieve the goals and offering ecosystem-specific “DO’s” and DON’Ts”. The final subsections of each ecosystem factsheet are about related recent or ongoing projects illustrating restoration in practice and delivering the most recent available scientific knowledge.

Pre-conditions for restoration

Restoration is not just about planting trees or removing concrete beddings. For restoration to be effective, proper planning, ongoing evaluation and adaptability are just as important as the implementation of a restoration measure itself. The restoration process can generally be formulated in five steps: Assessment, Planning and Design, Implementation, Ongoing Management and Monitoring and Evaluation (Nelson et al., 2024)[1]. Though presented in order here, it is important to keep in mind that the restoration process is not linear and components of this cycle might be worked on simultaneously or in different order. During any time of the restoration process, the themes of engagement, information sharing and adaptive management need to be considered and should shape the development of each component.

While more extensive guidance on how to fulfill each of the five components exist, the present document is designed as a quick-start hands-on guide. The following section provides some transversal DO’s and DON’Ts around each component.

Before you start any type of planning for your restoration, consider this: **DON’T proceed when the risk of significant deterioration cannot be reasonably excluded.**

If likely non-target impacts cannot be assessed (e.g., hydrological changes, soil disturbance, species introductions), do not implement irreversible actions. In such cases, doing nothing (for now) is preferable to causing additional damage or locking the system into a worse trajectory.

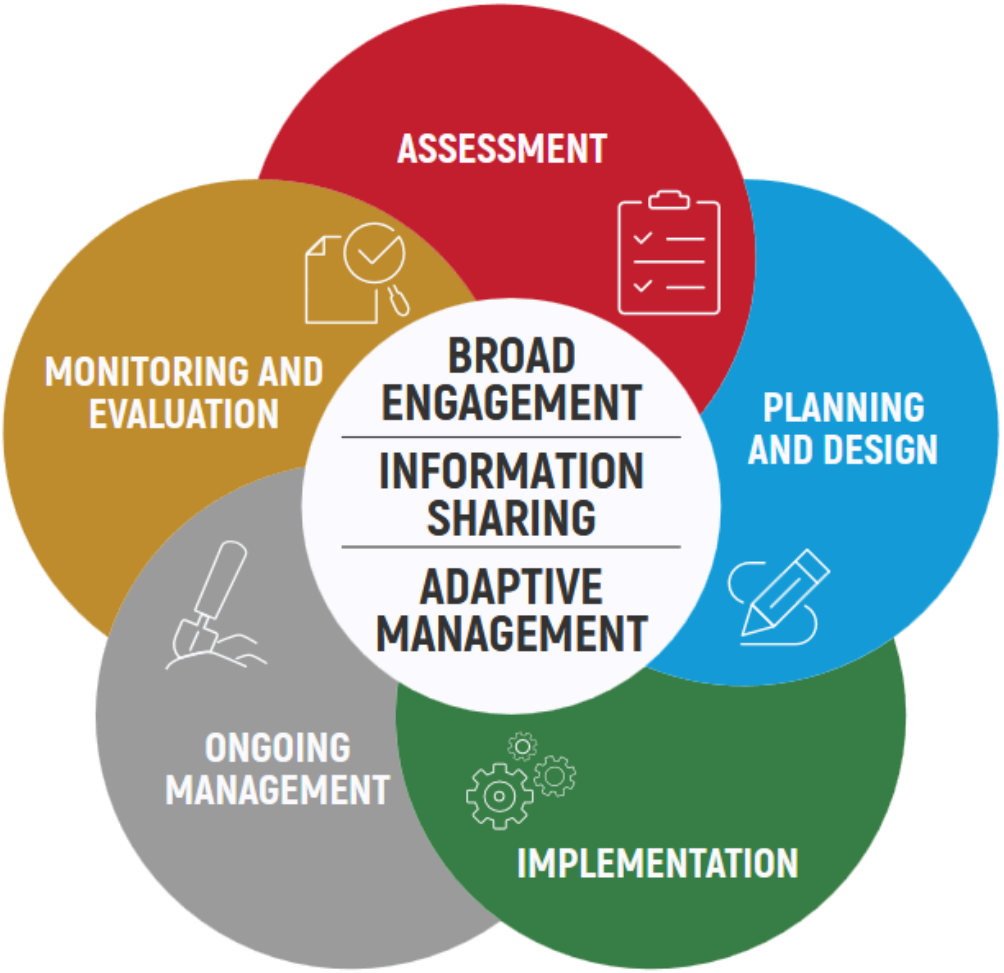

Figure 1: The restoration process consists of five core components, complemented by cross-cutting subcomponents that apply throughout. (Source: Nelson et al., 2024)[2]

[2] Nelson, C.R., Hallett, J.G., Romero Montoya, A.E., Andrade, A., Besacier, C., Boerger, V., Bouazza, K., Chazdon, R., Cohen-Shacham, E., Danano, D., Diederichsen, A., Fernandez, Y., Gann, G.D., Gonzales, E.K., Gruca, M., Guariguata, M.R., Gutierrez, V., Hancock, B., Innecken, P., Katz, S.M., McCormick, R., Moraes, L.F.D., Murcia, C., Nagabhatla, N., Pouaty Nzembialela, D., Rosado-May, F.J., Shaw, K., Swiderska, K., Vasseur, L., Venkataraman, R., Walder, B., Wang, Z., & Weidlich, E.W.A. 2024. Standards of practice to guide ecosystem restoration – A contribution to the United Nations Decade on Ecosystem Restoration 2021-2030. Rome, FAO, Washington, DC, SER & Gland, Switzerland, IUCN CEM. https://doi.org/10.4060/cc9106en

Transversal do's and don'ts in restoration

Assessment

DON'T start a restoration process without baseline data present.

Assessing restoration outcomes is about comparing it to pre-restoration conditions. If only diffuse knowledge about the extent and nature of the degradation to be tackled exist, no targeted restoration plan, monitoring scheme or measure selection can take place.

Make a proper assessment of baseline conditions and context in which restoration is to take place.

The baseline assessment does not necessarily need to be performed in line with the monitoring plan. It needs to generate enough data to allow for the planning of specific measures and target values to be monitored. Baseline assessment does not only regard ecological data but also information about the socio-economic and stakeholder context in which the restoration is planned.

Planning & design

DON'T start any works before all subsequent steps are planned.

Not planning ahead may result in decisions having adverse effects later on but no chance to change the course of actions at such a later stage.

Set up a restoration and monitoring plan spanning the entire process cycle.

Even though presented in an order here, the five phases don't happen strictly subsequently of each other, but overlap or need to be planned from the very start.

Make yourself aware of each step along the way, including evaluation and adaptive management iterations, before you start any restoration action.

Planning & design (continued)

DON'T prioritise short-term gains over long-term success.

Quick fixes, cosmetic projects, or politically motivated timelines undermine restoration. Rebuilding ecosystem resilience takes time for recovery.

Keep a large-scale, long-term vision.

Even a small restoration measure or a single project of a few years should be placed in the context of a long-term vision (for the ecosystem, region or country). This thinking should be included in the goals formulated for a project, maybe the first project is just to get the ball rolling and set the ground for subsequent projects to be more effective. Always include in the project a plan for upscaling the restoration to a larger scale (geographical/societal).

Ensure coherence with other policies.

Alignment is required in all restoration planning to avoid overlapping or counteracting measures and should thus take account of measures recommended by the CAP, Water Framework Directive (WFD), Marine Strategy Framework Directive (MSFD), Birds/Habitats Directives.

DON'T treat permitting as an administrative afterthought.

If overlapping biodiversity / landscape / heritage / water/land-use regimes apply, delays and redesigns are predictable; consider and plan for them upfront.

Create a one-stop "restoration authorisation pathway" per ecosystem type.

Map all required permits, competent authorities, expected timelines, and sequencing; publish it as part of NRP implementation guidance (or annex).

Planning & design (continued)

DON'T let process, price, or appearances replace ecological accountability.

DON'T outsource core ecological decisions to generic contractors without ecological accountability.

If ecological expertise is not embedded in governance, quality control collapses.

DON'T use procurement rules that select the cheapest offer at the expense of ecological outcomes.

Lowest-price contracting systematically undermines long-term success and monitoring.

Modernise procurement for restoration.

Use tender models that: (i) reward ecological outcomes not just outputs; (ii) require adherence to recognised restoration standards (e.g., SER); and (iii) enable qualified ecologists / botanists / technicians to participate meaningfully.

Standardise practice through a national "hub" function.

Establish/mandate/connect with the closest recognised technical-scientific structure that curates standards, protocols, training, and verified good practices and links with practitioners, public authorities and science (a "restoration culture" infrastructure).

DON'T overlook climate change impacts and the dynamics of global change in each socio-economic ecosystem.

Restoration that ignores future climate conditions risks maladaptation.

Integrate climate resilience.

All ecosystems must be restored in a way that increases resilience to climate stressors including heat, drought, storms, fires, sea-level rise. This includes anticipating changing species distributions with a warming climate.

Implementation

DON'T ignore root causes of degradation and systemic drivers.

Ignoring degradation drivers (pollution, drainage, overfishing, fragmentation, unfavourable structure or species composition) leads to immediate failure in any ecosystem.

DON'T allow or implement "restoration-washing".

Avoid projects that deliver visible outputs (e.g., planting) while pressures, baselines, and success criteria remain weak or absent.

Base actions on the best available science & data.

Use ecological evidence, local baselines, long-term monitoring and transparent indicators. Science-driven planning is universal across the NRR.

Apply a holistic/systemic vision of the area to restore, that allows for a broad understanding of all processes and interactions in a continuum-based perspective.

Choose areas for restoration based on scientific evidence regarding efficiency, likely success and favourable cost-benefit relation.

Want to know more?
https://www.biodiversa.eu/restoration/

DON'T rely on single-pressure or single-species fixes

Restoration needs to be systemic; isolated actions fail across ecosystems.

Focusing only on flagship species or more popular groups can increase public awareness but is not always the best solution for the entire system.

Restore ecosystem functions, not only species.

Focus on soil health, water regulation, nutrient cycling, carbon storage, pollination, etc. Functional restoration is universal and involves all components in need to be restored.

Address cumulative pressures.

Multiple stressors (i.e. pollution, land-use change, fragmentation, overexploitation) cannot be tackled individually. Address them holistically, together with climate changes and biodiversity loss and their interactions, within the Triple Planetary Crisis framework.

Implementation (continued)

DON'T oversimplify ecosystems or aim for "neat" landscapes.

Tidy aesthetics (e.g., cleared riverbanks, mown urban greenings, plantation-style forests) tend to impede ecological recovery.

Work with nature, not against it.

Nature-based solutions, natural processes (hydrology, succession, natural regeneration, soil regeneration), and ecological connectivity are fundamental to every ecosystem type article.

Embrace and plan for the natural dynamics present in ecological systems instead of assuming or prescribing ecosystems to be static.

DON'T ignore local context or stakeholder realities.

Top-down, non-participatory actions lead to conflict, resistance to restoration, and poor outcomes.

Ensure inclusive stakeholder engagement from the very beginning.

Farmers, fishers, landowners, foresters, indigenous groups, vulnerable groups, local administration, coastal communities, NGOs, scientists and citizens must be part of the planning and implementation everywhere. Participatory activities need to consider power dynamics and historical community context to ensure diversity and inclusivity.

Embed interdisciplinary expertise in governance structures.

Make ecological restoration a profession-led process: ecology + engineering + planning + law + social science, with clear roles and accountability.

Guarantee social fairness, co-benefits and transparency.

Restoration must benefit communities and avoid disproportionate impacts. There needs to be awareness of co-losses to be owned by everyone if restoration fails and the co-benefits it will bring to all actors when successful. Additionally, restoration actions should be aligned with a fairer ecological transition,

Implementation (continued)

considering the gender perspective and the creation of shared value in the territory through interdisciplinary approaches. Transparency in governmental processes and interests and activities of economic stakeholders enables adherence to these principles to be verified.

DON'T fragment or isolate restored areas.

In every ecosystem, isolated patches fail to deliver resilience or biodiversity.

DON'T isolate measures site-by-site when ecosystems are connected across jurisdictions (river basins, coasts, mountain ranges).

Fragmented action reduces effectiveness and increases conflict.

Prioritise ecological connectivity.

Corridors, buffer zones, migratory pathways, hydrological continuity. Connectivity is always there, for the bad and the good, and is thus a cross-cutting NRR requirement.

Ensure connectivity between protected and unprotected areas.

This does not mean, however, that only large restoration projects can be successful. Connectivity is less a question of dimension and more about the type of intervention. Protected and restored areas can create spillover effects to the adjacent non-restored areas.

Want to know more?
https://conbio.onlinelibrary.wiley.com/doi/10.1111/conl.12881

Implementation (continued)

DON'T use uncredited material to repopulate or reseed.

DON'T introduce or facilitate introduction or spread of invasive alien pathogens, pests, plants and animal species.

Restoration often fails completely due to pathogen infections introduced by the use of non-certified, infected nursery plants, seeds, algae, and corals, resulting in the loss of entire ecosystems.

Don't use nursery plants that are not certified pathogen-free (EU plant passports are not sufficient). Once introduced, plant pathogens, in particular those that are soilborne like *Phytophthora spp*., cannot be eradicated and will inevitably spread to adjacent ecosystems.

Use material from credited sources and with sufficient genetic diversity to support adaptive capacity.

Genetically narrow stock (from a single population or a handful of mother plants) limits a restored population's ability to cope with future climate stress, pests and disease.

Source seeds/propagules from multiple, genetically diverse donor populations rather than one stand or nursery batch. Favour local provenance, but consider climate-adjusted or composite sourcing (mixing in material from slightly warmer/drier populations) where projections suggest current local stock may be poorly matched to future conditions.

Keep traceability records of genetic origin (source population, collection site, number of donors) alongside the pathogen-free certification.

Want to know more?
https://www.biodiversa.eu/2026/07/08/restoration-materials/
https://www.biodiversa.eu/2026/07/08/nursery-accreditation-system/

Ongoing management

DON'T assume restoration ends after implementation.

Without monitoring, maintenance and adaptive changes, all restoration efforts will collapse sooner or later.

Specify a plan for ongoing management of your restoration site.

Maintenance of the implemented restoration is crucial for its long-term success. This can involve repeated clear-cutting or removal of non-native species or maintenance of built structures.

Monitoring & evaluation

DON'T restore without monitoring the process and outcomes.

If a restoration activity is not accompanied by a monitoring plan, there is no way to define whether it has reached its targets or even had adverse effects.

Ensure post-intervention impact monitoring and clear success criteria.

Use scientifically backed monitoring schemes with standardised indicators and target values, including clear target formulation for when a restoration project/measure is valued as a "success" or "complete"; Include not only ecological but also social, economic aspects.

Define upfront: (i) indicators and target values; (ii) minimum duration and frequency of monitoring; (iii) thresholds that trigger corrective actions (adaptive management); and (iv) when a measure can be considered "successful" versus "incomplete". Include ecological outcomes and, where relevant, social/economic outcomes (equity of benefits, acceptability, maintenance capacity).

Translate standards into operational checklists.

Convert existing restoration principles into procurement clauses, monitoring minimums, and site-level guidelines (including traceability of materials, monitoring designs, and success thresholds).

Use the adaptive management framework as the basis of your restoration plan and action.

Restoration must be iterative, monitored and adjusted over time (if needed); this is mandatory across the regulation.

NATURE RESTORATION REGULATION ARTICLE FACTSHEETS

Purpose of this section

This section provides factsheets for all articles of the NRR targeting ecological restoration action. It summarises goals and target values and gives example measures on how to achieve targets. Congruent with the transversal DO's and DON'Ts of restoration, ecosystem specific important considerations and pitfalls to avoid are presented.

Terrestrial, coastal and freshwater ecosystems (Article 4)

What the NRR requires

Article 4 of the Nature Restoration Regulation focuses on restoring terrestrial, coastal and freshwater ecosystems and the habitat types listed in Annex I. There are two main requirements.

1. Improve habitats that are not currently in good condition

Member States must restore Annex I habitat types that are not in good condition so that they improve towards good condition. The targets are:

- By 2030: at least 30% of the total area identified as needing improvement must be restored to good condition.
- By 2040: at least 60%.
- By 2050: at least 90%.

The areas covered by these targets are to be quantified through the National Restoration Plans. Restoration should also consider the connectivity of habitats and the ecological requirements of the species that depend on them. Restoring individual sites in isolation may not be enough if species cannot move between suitable areas or if the wider ecological conditions they need are not restored.

2. Re-establish habitat types where they have been lost

Article 4 requires Member States to re-establish Annex I habitat types in areas where those habitats no longer occur. The overall objective is to work towards the favourable reference area for each group of habitat types. The targets are:

- By 2030: restore at least 30% of the additional area needed to reach the favourable reference area.
- By 2040: restore areas representing at least 60% of that additional area.
- By 2050: restore 100% of the additional area.

This means restoration is not only about improving habitats that remain. It also involves bringing back habitats that have been lost from parts of their former range.

How to achieve – example measures

Restoration measures should be designed around the particular habitat and the ecological processes that support it.

Depending on the ecosystem, this can include:

- restoring habitat structure and function;
- improving connectivity between fragmented areas;
- reducing or removing the pressures that caused degradation;
- restoring natural hydrological processes where appropriate;

- improving soil condition and ecological function;
- using suitable and appropriately sourced planting material;
- preventing the introduction and spread of pests and pathogens;
- considering the wider landscape rather than treating individual sites in isolation; and
- monitoring outcomes over the long term and adapting management when the results are not as expected.

The emphasis should be on restoring functioning ecosystems, rather than simply planting species or completing physical works.

Pitfalls to avoid – specific DON'Ts

Starting restoration without a clear baseline

Restoration should not begin without sufficient information about the condition of the site. Baseline information is needed to understand what is degraded, what needs to change and how success will be measured. A useful baseline should consider the ecological condition of the site as well as relevant social, economic and stakeholder factors.

Restoring sites without addressing the cause of degradation

Restoration is unlikely to be successful if the underlying pressures remain.

For example, planting vegetation will not necessarily restore a coastal or wetland ecosystem if the hydrological conditions or other pressures that caused the degradation have not been addressed.

Using single-species solutions

Planting a single species or focusing on one visible component of an ecosystem can overlook the wider ecological processes needed for a functioning habitat.

Restoring disconnected sites

Individual restoration projects may have limited value if they remain isolated from other suitable habitat. Connectivity and the ability of species to move through the landscape need to be considered.

Prioritising rapid planting over ecological function

Fast implementation is not necessarily a measure of successful restoration. LIFE PRIMED showed the risks of focusing on planting without first addressing the ecological conditions needed for the habitat to function.

Using inappropriate planting material

Plant material can introduce pests and pathogens into previously unaffected ecosystems. Material needs to be appropriately sourced, checked and traceable.

Using poorly designed hydrological interventions

Changes to water levels and flows can have significant ecological consequences. Hydrological restoration needs to be based on sound ecological and scientific information rather than assumptions about what a site should look like.

Treating permits as something to solve after design

Restoration involving hydrological works, excavation or infrastructure may require multiple environmental, landscape, heritage or land-use authorisations. Identify these requirements early, as they may substantially affect project design and implementation.

Assuming restoration ends when works are completed

Restoration does not end when works are accomplished. Without monitoring, it is difficult to know whether the ecosystem is recovering, whether unexpected impacts are occurring or whether management needs to change.

Important Considerations - Specific DO's

Connectivity

Restoration planning should look beyond individual sites and consider how habitats connect across the wider landscape. Connectivity can be particularly important for species movement, recolonisation and maintaining ecological processes.

Landscape context

The effectiveness of restoration can depend on what is happening around the restoration site. InterRest highlights the importance of considering interactions between local and landscape-scale restoration, rather than viewing each restoration action as a standalone project.

Pressure reduction

The causes of degradation need to be identified and addressed wherever possible. Restoration should not simply treat the symptoms while leaving the underlying pressures in place.

Baseline information

Before restoration begins, there should be enough information to understand the existing condition of the ecosystem, establish appropriate targets and provide a basis for measuring change.

Soil health

For grassland ecosystems, earthworm abundance and soil organic carbon are identified as useful soil health indicators. These indicators are not currently mandatory under the NRR, but the guidance recommends that they should be considered in National Restoration Plans.

Hydrology

For wetlands, coastal systems and other water-dependent ecosystems, restoring appropriate water regimes and hydrological processes can be fundamental to successful restoration.

Biosecurity

Planting material needs to be carefully considered. Poor biosecurity can introduce invasive pathogens and create new problems in ecosystems that are otherwise being restored.

Climate and future conditions

Restoration planning should consider whether restored ecosystems will remain resilient under future climate and disturbance conditions.

Monitoring and adaptive management

Monitoring should be built into restoration from the beginning. It should have clear indicators, success criteria and target values, as well as defined points at which management will be reviewed or changed. Restoration should be treated as an adaptive process: assess what is happening, learn from the results and adjust management where necessary.

Social and economic context

Restoration takes place within social and economic systems. Where relevant, planning should consider stakeholder interests, the acceptability of restoration measures, equity of benefits and whether there is sufficient capacity and funding to maintain the restored ecosystem over time.

Evidence from practice

InterRest

Examined interactive effects of local and landscape scale restoration of semi-natural grasslands and agricultural fields on species interactions and ecosystem functions in different social-ecological systems. InterRest examined how restoration at both the local and landscape scale affects species interactions and ecosystem functions. The project highlights why restoration should not always be considered as a series of separate sites. The surrounding landscape and the interactions between restored areas can influence how well restoration delivers ecological outcomes.

This supports a broader approach to Article 4 restoration, where connectivity, landscape context and interactions between ecological and social systems are considered alongside the condition of individual habitats.

LIFE PRIMED

LIFE PRIMED provides practical lessons from coastal habitat restoration in Natura 2000 sites in Greece and Italy. The project demonstrated that restoration can fail when the pressures causing degradation are not properly addressed, when there is insufficient baseline information, or when rapid planting is prioritised over restoring the ecological processes that make the habitat function.

The project identified a number of approaches to avoid, including:

- relying on single-species solutions;
- carrying out isolated or non-holistic restoration actions;
- insufficient phytopathological checks;
- designing hydrological interventions without a sound scientific basis; and
- implementing restoration without adequate monitoring.

The project instead highlighted the importance of:

- reducing the pressures affecting the ecosystem;
- restoring hydrology and habitat processes at the ecosystem scale;
- using appropriate plant material;

- monitoring vegetation, soils, water and pathogens; and
- carrying out both ex-ante and ex-post monitoring.

One of the key lessons is that ecosystem processes need to be restored first, followed by ongoing management and adaptation. Without long-term monitoring and management, initial restoration gains can be fragile. Problems that are not identified early can also become more expensive to address, reducing the long-term benefits for biodiversity and climate resilience.

RESIPATH

Focused on effects and responses to invasive pathogens and their mitigation

RESIPATH examined the impacts of invasive pathogens and ways of reducing their spread. The project identified significant risks associated with nursery plants, particularly species such as alder, beech, chestnut and oak. Infected nursery material can introduce soilborne Phytophthora pathogens into forests, woodlands and riparian ecosystems.

These pathogens can contribute to tree decline and mortality and can affect important habitats, including beech and oak forests and riparian alder forests. The project demonstrates why biosecurity needs to be considered as part of restoration planning rather than treated as an issue separate from restoration.

A key recommendation is the need for a European nursery accreditation system based on high plant biosecurity standards and traceability. For restoration projects, this reinforces the importance of knowing where planting material comes from, ensuring that it is appropriately checked and maintaining traceability through the supply chain.

Practical restoration principles

Article 4 restoration should follow a clear process:

Assess → Plan and design → Implement → Manage → Monitor and evaluate

Stakeholder engagement and information sharing should occur throughout the process, with the ability to adapt management as new information becomes available.

Before implementation, restoration projects should have:

- a clear large-scale ecological vision;
- an understanding of the pressures causing degradation;
- sufficient baseline information;
- a clear reference trajectory for recovery;
- measurable ecological and, where relevant, social objectives;
- appropriate biosecurity controls and traceability of materials;
- the necessary permits and land tenure arrangements;
- early engagement with relevant stakeholders;
- funding for monitoring and long-term management;
- clearly defined indicators and success thresholds; and
- consideration of future climate and disturbance conditions.

Restoration should be reconsidered where significant deterioration or unacceptable impacts on non-target values cannot reasonably be ruled out. The overall principle is straightforward, restoration

should be based on evidence, address the causes of degradation, restore ecological processes and be monitored over time so that management can respond to what actually happens on the ground.

LIFE ÁGUEDA

LIFE Águeda provides scientific and practical frameworks for the eco-hydrological restoration of river continuity and diadromous fish population recovery within the Vouga River Basin in Portugal. The project identified the need to, and showed that, removing multi-scalar hydromorphological pressures requires a combination of strict structural interventions, empirical biological translocations, and community-integrated socio-economic management. The Águeda and Alfusqueiro rivers suffered from severe habitat fragmentation caused by over 140 artificial obstacles that blocked migratory fish species, such as the critically endangered European eel and sea lamprey, from reaching upstream spawning grounds. To resolve this without triggering community pushback, the project adopted a participatory strategy involving the removal of obsolete barriers, construction of nature-like rock fish passes, automated eel translocation, economic up-cycling through a sustainable fish labeling system, and citizen science monitoring.

- The project identified a number of approaches to avoid, including:
- Relying on artificial fishways without naturalised alternatives: installing rigid, engineering-heavy fish passes that fail to mimic natural river morphology and current dynamics.
- Addressing connectivity in isolation from riparian corridors: ignoring the critical ecological interactions between riverbed status, riparian vegetation health and adjacent floodplains.
- Allowing unregulated illegal or obsolete barriers to persist: leaving fragmented aquatic corridors unmitigated, which permanently restricts the migration of endangered diadromous species.
- Decoupling conservation science from local economic realities: implementing environmental restrictions on river usage without providing alternative, sustainable management tools for commercial and recreational fishers.
- Executing interventions without real-time telemetry: designing fish passages without deploying post-construction biological monitoring, such as PIT-tag telemetry, to empirically track passage efficiency.

The project instead highlighted the importance of:

- Restoring longitudinal connectivity at the catchment scale: systematically removing structural obstacles (e.g., obsolete weirs) to re-establish continuous lotic corridors.
- Implementing nature-like engineering solutions: using prototype fish passes that replicate natural structural and hydraulic conditions to support native ichthyofauna.
- Combining physical restoration with targeted biological management: executing proactive juvenile European eel translocation programs alongside physical habitat enhancements.
- Eradicating invasive flora and restoring native riparian galleries: controlling alien invasive vegetation and replanting autochthonous species to stabilize river margins and improve habitat resilience.
- Engaging stakeholders through technical and socioeconomic tools: developing mobile applications for citizen science monitoring (e.g. the Fishing in Portugal app) and establishing seals of origin to boost the market value of sustainably managed local fisheries.

One of the key lessons is that river restoration must integrate structural re-naturalisation with long-term ecosystem management and social co-responsibility. Restoring a river's physical connectivity is only the first step; maintaining its ecological status requires active monitoring of fish migration patterns, continuous management of invasive species, and the alignment of local commercial and recreational

practices. Without combining scientific telemetry with community-driven economic incentives, the long-term biological gains for critically endangered aquatic species and climate resilience remain highly vulnerable to systemic collapse.

Useful links

- RESIPATH – Biodiversa +
- Widespread Phytophthora infestations in European nurseries put forest, semi-natural and horticultural ecosystems at high risk of Phytophthora diseases - Jung - 2016 - Forest Pathology - Wiley Online Library
- High diversity of Phytophthora species in natural ecosystems and nurseries of Portugal: Detrimental side effect of plant introductions from the age of discovery to modern globalization - Horta Jung - 2025 - Plant Pathology - Wiley Online Library
- InterRest - Interactive effects of local and landscape-scale restoration of semi-natural grasslands and agricultural fields on species interactions and ecosystem functions in different social-ecological systems - Georg-August-Universität Göttingen
- LIFEPRIMED: https://webgate.ec.europa.eu/life/publicWebsite/project/LIFE17-NAT-GR-000511/restoration-management-and-valorisation-of-priority-habitats-of-mediterranean-coastal-areas https://www.lifeprimed.eu/it/
- LIFE Águeda Project, River Connectivity and Migratory Fish Restoration in the Vouga River Basin

Marine Ecosystems (Article 5)

What the NRR requires

Article 5 focuses on restoring marine ecosystems and the marine habitats listed in Annex II.

There are three main areas of action.

1. Improve marine habitats that are not in good condition

Member States must improve areas of Annex II habitat types that are not currently in good condition. The targets are:

- By 2030: improve at least 30% of the area identified as not being in good condition.
- By 2040: improve at least 60%.
- By 2050: improve at least 90%.

The areas to which these percentages apply are those quantified in the National Restoration Plans. Importantly, the targets apply to the area of habitat that is not in good condition, rather than to the total area over which the habitat occurs. Restoration planning should also consider ecological coherence and connectivity between Annex II habitat types and the ecological requirements of the species that depend on them.

2. Re-establish marine habitats where they have been lost

Article 5 also requires the re-establishment of Annex II habitat types in areas where those habitats no longer occur. The objective is to work towards the favourable reference area for the relevant habitat groups. The targets are:

- By 2030: restore at least 30% of the additional area needed to reach the favourable reference area.
- By 2040: restore areas representing at least 60% of that additional area.
- By 2050: restore 100% of that additional area.

3. Restore marine habitats needed by protected species

The NRR also requires restoration of marine habitats used by species listed in Annex III of the NRR, as well as species covered by Annexes II, IV and V of the Habitats Directive and wild birds covered by the Birds Directive.

The aim is to improve both the quality and quantity of these habitats and increase their connectivity until sufficient habitat quality and quantity has been achieved.

Where necessary, this can also include re-establishing the species themselves.

How to achieve – example measures

The appropriate restoration measure will depend on the habitat, the cause of degradation and the ecological conditions of the site.

Sustainable mooring systems (Habitat group 1)

In areas affected by anchoring, sustainable mooring systems can reduce physical damage to marine habitats. The LIFE terrAmare project also demonstrates the value of working directly with local fishers to reduce fishing pressure and support the regeneration and health of marine ecosystems.

Climate-adapted marine forest restoration (Habitat group 2)

RESTORESEAS used information on biodiversity trends, past climate conditions and future IPCC climate projections to identify marine forests that are particularly vulnerable to climate change. This approach can help identify where restoration needs to take future climate conditions into account rather than simply attempting to recreate historical conditions.

Removal of debris and ghost gear (Habitat group 5)

LIFE DREAM provides an example of restoration in deeper waters, including the removal of debris and lost fishing gear from the seafloor in areas supporting cold-water corals. The project also used remotely operated vehicles and specially designed artificial structures near degraded deep reefs to provide opportunities for coral and coralligenous species to grow.

Pitfalls to avoid – specific DON'Ts

Using the total habitat area to calculate the restoration target

The 30%, 60% and 90% targets for improving habitat condition apply to the area that is not in good condition. They do not mean that 30%, 60% or 90% of the entire distribution of a habitat must be restored. Getting this denominator wrong could substantially distort the scale of restoration required.

Starting restoration without a reliable baseline

Restoration should not begin until there is a reliable understanding of the habitat's distribution and condition. Without a baseline, it is difficult to determine where restoration is needed, what condition the habitat was in before intervention or whether the restoration has actually improved ecological outcomes.

Leaving the cause of degradation unchanged

Restoration should address the pressures responsible for habitat degradation.

For example, restoring an area while continuing the activity that is damaging the habitat can undermine or reverse the restoration effort.

Treating marine habitats as isolated patches

Marine ecosystems are connected. Restoration planning should consider ecological coherence and connectivity between habitats, as well as the needs of the species that depend on them. A collection of

restored sites may not provide the same ecological benefit as a connected network of functioning habitats.

Focusing on physical restoration without considering future conditions

Marine ecosystems are subject to changing environmental conditions, including climate change. Restoration approaches that ignore future conditions may be poorly suited to maintaining healthy ecosystems over the longer term.

Important Considerations - Specific DO's

Habitat mapping

Good restoration planning depends on knowing where marine habitats occur and understanding their distribution. Mapping provides the foundation for identifying areas requiring restoration and for planning restoration at an appropriate scale.

Condition assessment

It is important to distinguish between the total area where a habitat occurs and the area that is actually degraded or not in good condition. Condition assessment therefore needs to be carried out before restoration targets and measures are determined.

Connectivity and ecological coherence

Marine habitats should not be considered in isolation. Planning should consider connections between habitats and the ecological requirements of the species that use them.

Understanding and reducing pressures

Restoration measures should be linked to the pressures affecting the habitat. This may include physical damage, fishing pressure, debris or other pressures identified through site assessment.

Climate adaptation

Restoration planning should consider future climate conditions. RESTORESEAS demonstrates how historical climate information and future climate projections can be used to identify areas where restoration approaches may need to be adapted.

Biosecurity and pathogen-free donor material

Restoration can itself create risks if infected material is introduced into marine ecosystems. There have been cases where oomycete pathogens have been involved in seagrass decline and diseases affecting brown algae along European coasts. For seagrass restoration, only plants from tested oomycete pathogen-free donor populations or plants grown from seed should be used. This is particularly important because restoration material can potentially introduce pathogens into areas where they were previously absent.

Stakeholder engagement

Marine restoration frequently takes place in areas used by different groups, including fishers and other marine users. Early engagement can help identify existing pressures, practical constraints and opportunities to reduce activities that are damaging habitats.

The LIFE terrAmare example demonstrates how collaboration with local fishers can form part of a restoration approach.

Monitoring and adaptive management

Restoration should include monitoring from the beginning. Monitoring should establish whether the habitat is improving, whether pressures have been reduced and whether the restoration measures are producing the expected ecological outcomes. Where results differ from expectations, management should be capable of being adjusted.

Evidence from practice

RESTORESEAS

RESTORESEAS tested restoration approaches aimed at addressing critical pressures on marine forests and preventing or reversing ecological tipping points. The project brought together global data and modelling approaches to develop predictions about restoration and conservation needs. It also considered adaptive traits that may be important when planning restoration under changing environmental conditions. An important part of the project was its examination of the effects of climate change on marine forests. By comparing biodiversity trends with past climate conditions and future IPCC climate projections, the project identified marine forests that may require climate-adapted restoration strategies.

The project also highlighted pathogen risks relevant to marine restoration.

Research demonstrated the involvement of oomycete pathogens in seagrass decline and diseases of brown algae along European coasts. For seagrass restoration, the resulting recommendation is clear, use only plants from tested pathogen-free donor populations or plants grown from seed. The broader lesson is that marine restoration needs to consider not only the condition of the habitat today, but also the environmental conditions it is likely to experience in the future.

LIFE-MAPPER

LIFE-MAPPER brought together knowledge, methodologies and good practices relating to marine habitat mapping, conservation and restoration across European seas.

The project aims to consolidate fragmented information and improve the way marine habitat information is used for decision-making. It integrates different datasets and mapping approaches into a digital manual and a Knowledge Platform, including searchable information, datasets and a GeoPortal for mapping services.

This is particularly relevant to Article 5 because effective marine restoration depends on having a clear understanding of:

- where habitats occur;
- their condition;
- where restoration is needed;

- how habitats are connected; and
- how restoration needs can be incorporated into wider marine spatial planning.

The project is intended to strengthen decision-making and address knowledge gaps that affect the protection and restoration of Europe's marine biodiversity.

Practical restoration principles

Marine restoration should follow a clear process:

Assess → Plan and design → Implement → Manage → Monitor and evaluate

Before restoration begins, there should be enough information to establish:

- where the habitat occurs;
- the condition of the habitat;
- the area that is not in good condition;
- the additional area required to reach the favourable reference area, where applicable;
- the main pressures affecting the habitat;
- the ecological connections between habitats;
- the requirements of species using the habitat;
- the suitability of the proposed restoration approach under future climate conditions; and
- the potential risks associated with restoration materials.

Restoration measures should then be designed to:

- improve ecosystem structure and function;
- reduce the pressures responsible for degradation;
- improve connectivity and ecological coherence;
- take future climate conditions into account;
- avoid introducing pathogens or other harmful organisms;
- involve relevant stakeholders, including marine users where appropriate; and
- include clear monitoring and success criteria.

The central principle is that marine restoration should not simply recreate a physical habitat in one location. It should address the causes of degradation, restore functioning ecosystems, maintain connections between habitats and species, and be designed to remain effective as environmental conditions change.

LIFE SeagrassRIAwild

LIFE SeagrassRIAwild provides practical lessons for restoring endangered underwater seagrass beds in the Ria de Aveiro coastal lagoon in Portugal. The project demonstrated that traditional restoration can fail when it relies on harvesting fragile wild plant populations without integrating local economic interests and human pressures. The problem addressed is that of Zostera marina meadows that have severely declined in Portugal, including in the Ria de Aveiro, where the species was locally absent for around a decade. Restoration is constrained by the limited availability of healthy donor populations and restoration material, making conventional transplantation difficult to scale. LIFE SeagrassRIAwild aims to restore subtidal seagrass meadows by developing mariculture techniques to produce Zostera marina plants and seeds at scale. The project combines nursery production with conventional restoration and Nature-based Solutions, while assessing genetic diversity, ecosystem recovery and ecosystem

services. It also involves stakeholders, practitioners and citizens to support long-term, scalable seagrass rewilding. In short: From scarce natural donor material to scalable mariculture-based restoration of seagrass meadows.

- The project identified a number of approaches to avoid, including:
- Harvesting excessive plants from wild donor beds;
- Carrying out isolated restoration without local users;
- Ignoring the economic needs of the area; and
- Relying entirely on short-term external funding.

The project instead highlighted the importance of:

- Using mariculture for large-scale plant production;
- Co-designing Nature-based Solutions with stakeholders;
- Using targeted citizen science; and
- Combining conservation with active lagoon management.

One of the key lessons is that seagrass restoration must shift away from disturbing wild donor beds toward sustainable, tank-grown mariculture. Without long-term community co-ownership and clear benefits for local maritime activities, newly planted underwater meadows remain vulnerable to human disruption.

Useful links:

- Life Mapper: https://www.life-mapper.eu/en/
- Restore Seas: https://www.restoreseas.net/
- LIFE SeagrassRIAwild: https://life-seagrassriawild.web.ua.pt/

Urban Ecosystems (Article 8)

What the NRR requires

Article 8 focuses on urban ecosystems, i.e. green spaces in urban settings. Though these spaces are by definition much smaller and more fragmented than near-natural ecosystems, urban green spaces can offer a wide range of ecosystem services especially for humans, e.g. cooling or improved rainwater drainage. There are two main requirements:

1. No net loss of urban green space until 2030, followed by an increasing trend in urban green space coverage

Member States need to prevent net loss of urban green space and, starting 1 January 2031 establish measures to increase urban green space coverage, including through the integration of urban green space into buildings and infrastructure. The target is to reach a satisfactory level, as defined in the National Restoration Plans (Article 14(5)).

For this, Member States have to determine and map the extent of urban ecosystem areas for all their cities and towns. Depending on the approach taken by the Member State, urban ecosystem areas may encompass the entire city, town or suburb, or urban centres, urban clusters and, where considered appropriate, peri-urban areas. Urban ecosystem areas of two or more adjacent cities, towns or suburbs may be aggregated. Member States may exclude urban ecosystem areas where the share of urban green space in urban centres and urban clusters exceeds 45%.

Increasing urban green space may include integrating green space into buildings and infrastructure.

Net loss is measured at the total national area of urban green space.

How to achieve – example measures

Urban green space can be increased through a combination of land-use planning, redevelopment and restoration measures, including:

Convert underused parking spaces or vacant buildings into pocket parks, using permeable pavement and planted swales where appropriate.

- Combine greening with urban densification, for example by replacing single houses with multi-family buildings while retaining or increasing green infrastructure.
- Integrate mandatory or voluntary greening objectives into urban renewal permits.
- Define a minimum area of green space to be conserved in greenfield or brownfield development.
- Raise development fees and invest these in additional public urban green space.
- Develop and implement an Urban Nature Plan that integrates green-space development with human health, urban planning and infrastructure planning.

- Improve urban soil health through mechanical decompaction, such as subsoiling or air spading, followed where appropriate by the incorporation of compost or biochar to rebuild soil organic matter and structure.
- Replace impervious surfaces with permeable pavers or porous asphalt in appropriate locations, such as parking areas and schoolyards, to restore soil–water connectivity.
- Use certified pathogen-free mulch or compost.

Pitfalls to avoid – specific DON'Ts

- Do not assume that installing permeable pavement alone will provide a lasting restoration benefit. Permeable pavements require regular maintenance, such as vacuum sweeping, to remain functional; without appropriate maintenance they can become sealed again within a few years.
- Do not assume that de-sealing automatically restores the underlying soil. Exposed soils may remain compacted and nutrient-poor and may not support vegetation or soil fauna without further restoration measures.
- Avoid fragmented de-sealing consisting of small, isolated patches where these do not contribute to wider green infrastructure. Connecting restored areas can increase their ecological value.
- Do not create increasing areas of green space without considering the resources required for their long-term management and maintenance.
- Do not treat green space as merely “nice to have”; urban green infrastructure should be considered strategic infrastructure.
- Avoid green gentrification and consider how the benefits and costs of urban greening are distributed across communities.

Important considerations – specific DO’s

- Use exclusively certified pathogen-free plant material.
- Consider urban green space as an inter-departmental responsibility, crossing departmental silos and budget lines.
- Design new urban green spaces with realistic, low-maintenance requirements where possible.
- Focus on providing urban green space to underserved areas and communities.
- Prioritise de-sealing in areas that can connect existing green spaces and create ecological corridors.
- Use native, climate-resilient plant species in newly unsealed areas where appropriate, taking account of local soil conditions and supporting pollinators and urban biodiversity.
- Monitor earthworm recolonisation as a simple bioindicator of restored soil function.
- Use urban restoration sites as living laboratories, for example, combining simple treatment/control designs where possible with repeatable indicators of vegetation, soil, biodiversity and microclimate.

2. No net loss of urban tree cover until 2030, followed by an increasing trend in urban tree canopy cover

Member States need to prevent net loss of urban tree canopy cover and, starting 1 January 2031 establish measures to increase urban tree canopy cover. The target is to reach a satisfactory level, as defined in the National Restoration Plans (Article 14(5)).

Member States may exclude urban ecosystem areas where the share of urban tree cover exceeds 10%. Net loss is measured against the total national area of urban tree cover. Increases in urban tree cover also contribute to Article 13, concerning the planting of three billion additional trees.

How to achieve – example measures

- Integrate mandatory or voluntary tree-planting requirements into grey and green infrastructure projects and urban redevelopment projects on both public and private land.
- Add trees to existing urban green spaces, including lawns and recreational areas.
- Retain existing trees as part of urban development and restoration planning, rather than relying only on new tree planting.

Pitfalls to avoid – specific DON'Ts

- Do not focus only on planting new trees. Conserving existing trees is equally important, particularly where established trees already provide urban canopy and other ecosystem functions.
- Don’t measure success only through trees planted or initial survival. Long-term establishment, vegetation structure and ecological function are more informative restoration outcomes.

Important considerations – specific DO’s

- Plant the right tree or assemblages in the right place, taking account of changing climate conditions, soil conditions and potential impacts on surrounding infrastructure.
- Protect and, where necessary, improve the soil and both the above-ground and below-ground growing space available to newly planted trees.
- Use exclusively certified pathogen-free plant material.
- Consider stewardship by citizens, including support for watering newly planted trees during dry seasons where appropriate.

Evidence from practice

CLEVER Cities

Provides practical examples of integrating nature-based solutions into urban planning and regeneration. https://www.urbannatureplans.eu

proGIreg

Demonstrates approaches for integrating nature-based solutions into the regeneration of post-industrial urban areas. https://progireg.eu

EnRoute

Provides evidence and approaches linking urban green infrastructure, biodiversity and urban planning. https://publications.jrc.ec.europa.eu/repository/handle/JRC115375

BiodiverCities

Provides examples of incorporating biodiversity considerations into urban planning and city-scale decision-making. https://knowledge4policy.ec.europa.eu

Urban Nature Plans+ (UNPplus)

Provides resources and approaches for developing Urban Nature Plans and integrating urban nature into wider planning processes. https://www.urbannatureplans.eu

CLEARING HOUSE

Provides knowledge and practical examples concerning urban forests, biodiversity, resilience and human well-being. https://www.clearinghouseproject.eu/

REGREEN project

Provides examples of nature-based solutions for sustainable and resilient urban development. https://www.regreen-project.eu

NetworkNature

Provides resources and knowledge exchange on nature-based solutions, including approaches relevant to urban biodiversity, resilience and planning. https://networknature.eu

Further resources

- JRC Handbook of planning tools for urban greening (2025): https://publications.jrc.ec.europa.eu/repository/handle/JRC144165
- Eionet report on green infrastructure and urban biodiversity: https://www.eionet.europa.eu/etcs/etc-bd/products/etc-bd-reports/gi_urban_biodiversity/
- EU Ecosystem Typology for National Restoration Plans: https://biodiversity.europa.eu/europes-biodiversity/nature-restoration
- Urban Nature Platform: https://environment.ec.europa.eu/topics/urban-environment/urban-nature-platform_en
- Greening Cities Partnership: https://www.urbanagenda.urban-initiative.eu/partnerships/greening-cities
- Urban By Nature: https://urbanbynature.eu/
- Berlin Urban Nature Pact: https://citieswithnature.org/berlin-urban-nature-pact/
- Biodiversa+ Policy Brief Resilient Urban Waters: https://www.biodiversa.eu/2026/07/08/urban-waters/

Rivers and Floodplains (Article 9)

What the NRR Requires

Article 9 focuses on the restoration of river ecosystems, specifically the natural connectivity of rivers and the natural functions of their related floodplains. There are two main requirements:

1. Remove artificial barriers to the connectivity of surface waters

The target is to remove artificial barriers to the connectivity of surface waters as identified during the preparation of the NRPs. The NRR places particular emphasis on restoring the connectivity of rivers by addressing artificial barriers that interrupt natural river processes and the movement of aquatic organisms.

Specifically, measures should ensure that the natural connectivity of rivers and the natural functions of related restored floodplains are maintained.

Member States should primarily target obsolete barriers that are no longer needed for renewable energy generation, inland navigation, water supply, flood protection or other uses.

How to achieve – example measures

A range of measures can be used to restore river connectivity and allow more natural river processes to resume.

- Remove obsolete dams and other longitudinal barriers. Removing a dam can allow flow velocity, discharge and bank-forming processes to develop more naturally and can restore upstream and downstream movement for migratory fish and macroinvertebrates.
- Remove artificial bank armouring and embankments where appropriate. For example, removal of artificial stone armouring along the Danube east of Vienna enabled the river to shape its channel morphology more naturally and reconnect with side channels and the floodplain. This can create habitat, reduce flow velocity and flood peaks, and allow more water to remain in the surrounding landscape.
- Remove or modify groynes and other structures that disconnect rivers from their floodplains. Groynes extending perpendicular to the river bank can deepen the channel and cause incision, disconnecting the floodplain. Removing such structures and, where necessary, reintroducing missing sediment can help reconnect the floodplain with the river.

Pitfalls to avoid – specific DON'Ts

- Do not remove a dam without assessing the sediment stored behind it. Longitudinal dams can trap large quantities of sediment, and removing them can release excessive or contaminated sediment downstream.
- Avoid flushing excessive quantities of sediment, including potentially toxic sediment, into downstream ecosystems and infrastructure following barrier removal.

- Do not assess barrier removal only at the location of the barrier. Effects can extend upstream and downstream through changes in sediment transport, flow, channel morphology and connectivity.

Important considerations – specific DO's

- Consider downstream infrastructure, including bridges and water abstraction, and plan how these may be affected by barrier removal.
- Consider the wider river system and the space required for natural river processes. Consider restoration at the scale of the river and its surrounding floodplain rather than treating individual barriers as isolated engineering problems.
- Engage surrounding stakeholders very early in the restoration process and remain open to their views and needs.
- Recognise that restoring natural river morphology can change both the appearance of a river and the amount of space it requires.
- Where artificial barriers are removed, restoration should also consider the natural functions of the associated floodplain.

2. Improve the natural functions of floodplains associated with restored river systems

No specific numerical target is specified in the NRR, but the objective is to ensure that the natural connectivity of rivers and the natural functions of related restored floodplains are maintained.

Floodplain restoration should therefore be considered alongside river restoration. Reconnecting a river with its floodplain can restore hydrological processes and create conditions for a wider range of aquatic and terrestrial habitats.

How to achieve – example measures

- Reconnect side-arms and depressions so that they receive water during high-flow events. This maintains active hydrological dynamics and can create habitat for floodplain-specific terrestrial and aquatic biodiversity, including refuges and spawning grounds for fish.
- Block drainage pipes where appropriate to retain water in the floodplain. This can contribute to protection against both floods and droughts.
- Remove non-native vegetation and replace it with native floodplain species where appropriate. Native floodplain vegetation can support natural floodplain development, contribute to bank erosion control and water purification during flood events, and provide habitat for floodplain-dependent organisms as well as migratory birds and large mammals.
- Restore the physical and hydrological processes that allow floodplains to function as connected parts of river systems rather than isolated areas of land.

Pitfalls to avoid – specific DON'Ts

- Do not assume that morphological restoration alone will restore floodplain functions. Improvements can remain limited where catchment-scale water balance and pollution are not addressed at the same time.
- Do not introduce pathogens or invasive species through floodplain and riparian planting material.

- Avoid treating floodplain restoration as an isolated site intervention when pressures elsewhere in the catchment continue to constrain recovery.

Important considerations – specific DO's

- Recognise that process-based restoration does not always produce a precisely predictable outcome. Restoration aims to re-establish natural processes, but the resulting ecosystem structure and functions will also depend on external environmental factors such as weather and geology.
- Plan for change over time rather than defining restoration success solely by the immediate appearance of the restored site.
- Use monitoring and adaptive management to understand how the restored river and floodplain develop and to respond where necessary.
- Consider the wider catchment when assessing water balance, pollution and other pressures affecting floodplain recovery.
- Ensure that all planting and restoration materials are appropriately checked to prevent the introduction of pathogens and invasive species.

Evidence from practice

MERLIN (Mainstreaming Ecological Restoration of freshwater-related ecosystems in a Landscape context: INnovation, upscaling and transformation)

MERLIN provides practical examples of freshwater restoration at landscape scale. Examples include removal of artificial barriers, reconnection of floodplains and restoration of river processes.

The project illustrates how removing barriers and artificial bank structures can allow rivers to develop more natural morphology and reconnect with side channels and floodplains. These changes can create additional habitat, influence flow velocities and flood peaks, and increase the amount of water retained within the surrounding landscape: https://project-merlin.eu/.

CRC RESIST (Collaborative Research Centre on multiple stressors affecting streams and rivers)

CRC RESIST investigates how multiple stressors interact in streams and rivers. Through manipulative laboratory and field experiments, field studies and modelling, the project examines why, when and how stressors interact and develops options for mitigation and restoration. This work highlights the importance of considering multiple pressures rather than addressing individual restoration problems in isolation: https://sfb-resist.de/.

RESIPATH (Responses of European Forests and Society to Invasive Pathogens)

RESIPATH demonstrated the risks posed by invasive Phytophthora pathogens to riparian ecosystems. Research associated with RESIPATH and other projects demonstrated widespread severe dieback and mortality of alder and poplar trees in riparian forests caused by introduced, invasive soil- and waterborne Phytophthora pathogens. Following introduction into river systems through infected nursery plants, pathogens can spread downstream and infect riparian trees.

A key restoration precaution is therefore to use only plants from certified Phytophthora-free nurseries for restoration planting.

https://www.biodiversa.eu/2022/10/31/resipath/

https://doi.org/10.1111/efp.12239

https://doi.org/10.1111/ppa.14022

Further resources

- The Resilient Watersheds Toolbox – a comprehensive collection of resources on watershed management and restoration techniques. https://resilientwatershedstoolbox.org/
- Floodplains: a natural system to preserve and restore – an EEA report providing an overview of floodplain functions, restoration and the contribution of natural floodplains to multiple EU policy objectives.
  https://www.eea.europa.eu/en/analysis/publications/floodplains-a-natural-system-to-preserve-and-restore

Pollinators (Article 10)

Article 10 focuses on safeguarding pollinator communities and improving their diversity. It has one main target:

1. Reverse the decline of pollinator populations at the latest by 2030 and thereafter achieve an increasing trend of pollinator populations.

To achieve this, Member States shall ensure that monitoring data comes from an adequate number of sites to ensure representativeness across their territories. Member States should also promote citizen science in the collection of monitoring data where suitable and provide adequate resources for the performance of those tasks.

How to achieve — example measures

- Establish a representative monitoring network that covers the range of habitats and landscapes where pollinators occur.
- Establish baseline data before restoration measures are implemented so that changes in pollinator populations and diversity can be assessed against pre-restoration conditions.
- Restore and manage semi-natural habitat for pollinators at the landscape scale, rather than relying on isolated restoration sites, to provide sufficient and connected resources for pollinator populations.
- Set taxon-specific targets for the amount of semi-natural habitat to restore, recognising that habitat requirements differ among pollinator groups.
- Use restoration measures that increase both the quantity and quality of semi-natural habitat, including diverse and season-long floral resources, nesting opportunities and suitable management regimes.
- Include pollinator needs in restoration planning for agricultural, urban and other ecosystems where pollinator habitat can be restored or improved, including when possible connectivity in the design
- Use monitoring indicators and target values that can demonstrate whether restoration measures are improving pollinator populations and diversity.
- Avoid relying on a single pollinator group as an indicator of restoration success.
- Use citizen science where appropriate to expand monitoring coverage and involve communities in collecting observations.
- Provide adequate resources, training and coordination for citizen-science monitoring where it is used.
- Use monitoring results to adapt restoration measures where targets are not being met or unexpected impacts occur.

- Consider the wider ecological and social context of restoration, including land management, stakeholder interests and the long-term capacity to maintain restored areas.

Pitfalls to avoid — specific DON'Ts

- Don't start restoration without baseline data. Without a clear starting point, it is difficult to determine whether pollinator populations have improved.
- Don't rely on a small number of monitoring sites that do not adequately represent the territory or the range of conditions being restored.
- Don't treat monitoring as an activity separate from restoration. Monitoring needs to be designed alongside the restoration measures and funded for the post-intervention period.
- Don't focus only on the number of pollinators recorded at individual sites. Restoration needs to be considered in relation to wider ecosystem condition, connectivity and the pressures affecting pollinator populations.
- Don't implement isolated measures without considering connectivity. Fragmented restoration can limit the ability of species to move between suitable areas.
- Don't assume that small, high-quality habitat patches for pollinators can compensate for a lack of wider semi-natural habitats for pollinators at landscape scale.
- Don't evaluate restoration solely against the lowest habitat threshold or the needs of the least demanding pollinator taxon.
- Don't create resources that are short-lived, poorly managed or restricted to a narrow flowering period. Pollinators need diverse, season-long floral resources alongside nesting and overwintering habitat.
- Don't use restoration measures without first identifying the main degradation pressures. If the pressures responsible for decline remain in place, restoration outcomes may be limited.
- Don't use uncredited or unsuitable biological material for restoration or reseeding.
- Don't introduce or facilitate the spread of invasive species, pests or pathogens through restoration activities.
- Don't rely on citizen science without appropriate coordination, resources and monitoring methods. Citizen science should complement a robust monitoring approach where it is suitable.

Important considerations — specific DO's

- Do establish a representative monitoring network covering the relevant range of landscapes and conditions.
- Do define pollinator taxon-specific baseline conditions, indicators and target values before implementation.
- Do establish clear criteria for success and define the thresholds that would trigger corrective or adaptive action per pollinator taxon.
- Do use standardised monitoring approaches where possible so that results can be compared over time and between sites.
- Do combine ecological monitoring with appropriate social and economic information, including stakeholder acceptance and capacity to maintain restoration measures.
- Do promote citizen science where it is suitable, with adequate resources and appropriate methods.
- Do address pollinator habitat quantity and habitat quality together.
- Do use the adaptive pollinator management approach: monitor results, assess progress and adjust measures where required.

- Do consider connectivity and restoration at the landscape scale, rather than treating individual sites as isolated interventions.
- Do use material from credible sources with sufficient genetic diversity where seeds or other biological material are required for restoration.
- Do ensure traceability and appropriate checks for restoration materials.
- Do consider future climate and disturbance conditions when selecting and designing restoration measures.
- Do translate restoration principles into practical site-level guidance, procurement requirements and monitoring protocols.

Evidence from practice

Safeguard

Safeguard integrates research, NGOs and industry to understand the drivers of pollinator decline, assess impacts and develop policy-relevant solutions for field, farm and urban systems. Safeguard Project Database

ProPollSoil

ProPollSoil investigates the critical link between soil health and soil-dwelling pollinators. The project incorporates citizen science to promote sustainable soil practices: Understanding and managing soil health impacts to protect soil-dependent pollinators | ProPollSoil | Project | Fact Sheet | HORIZON | CORDIS | European Commission

AGRI4POL

AGRI4POL promotes sustainable agricultural practices that benefit pollinators through the EU Common Agricultural Policy (CAP) Network: Promoting sustainable agriculture for pollinators | AGRI4POL | Project | Fact Sheet | HORIZON | CORDIS | European Commission

Useful Links

- Critical habitat thresholds for effective pollinator conservation in agricultural landscapes. DOI: 10.1126/science.adr2146
- Improving ecosystem services in farmlands: beginning of a long-term ecological study with restored flower-rich grasslands: https://doi.org/10.1080/20964129.2022.2090449
- Landscape-wide floral resource deficit enhances the importance of diverse wildflower plantings for pollinators in farmlands: https://doi.org/10.1016/j.agee.2024.108984
- Synthesis of Pollinator-Friendly Management in European Protected Areas: https://doi.org/10.1111/cobi.70366 (in protected areas but mentions agriculture)

Agricultural Systems (Article 11)

Article 11 focuses on safeguarding biological communities and ecosystem functions in agricultural areas. There are four main courses of action:

1. Enhance biodiversity in agricultural ecosystems

The target is to enhance biodiversity in agricultural ecosystems while taking into account climate change, the social and economic needs of rural areas and the need to ensure sustainable agricultural production in the Union.

How to achieve — example measures

- Use diversified, biodiversity-friendly farming systems that reduce dependence on external inputs and support wildlife while maintaining agricultural production.
- Restore, maintain and appropriately manage a diverse network of high-diversity landscape features within agricultural landscapes.
- Improve soil condition and the ecological functions that support agricultural biodiversity.
- Plan restoration at landscape scale rather than relying only on isolated farm-level measures, fostering agricultural landscape heterogeneity
- Improve connectivity between habitats across agricultural landscapes.
- Use farming practices that support soil biodiversity, soil structure, organic carbon and water storage where these are relevant to the restoration objective.
- Work with farmers and land managers to develop measures that fit local farming systems and conditions.
- Monitor outcomes at field and landscape scales, using indicators that capture both biodiversity and ecosystem functioning and services.

Pitfalls to avoid — specific DON'Ts

- Don't rely on single "silver-bullet" measures, such as flower strips alone, to restore biodiversity.
- Don't simplify agricultural landscapes into large, uniform fields.
- Don't treat agricultural restoration as a collection of isolated farm-level projects.
- Don't apply one restoration approach across different agricultural landscapes without considering local management and conditions.
- Don't focus on individual species while overlooking the wider agricultural ecosystem.
- Don't ignore the pressures driving biodiversity loss or soil degradation.
- Don't separate biodiversity objectives from the practical needs of farmers and rural communities.
- Don't use soil indicators or targets without considering the local soil type, climate and management context.

Important considerations — specific DO's

- Work at landscape scale where biodiversity, water, soils and ecological connectivity extend beyond individual farms.
- Enhance diverse landscape mosaics including varied crop types and rotations, semi-natural habitat patches, and variation in field size, shape, and structural elements.
- Use a diverse portfolio of biodiversity-friendly management practices across the agricultural landscape.
- Involve farmers, landowners and other rural stakeholders from the beginning.
- Consider climate change and future conditions when selecting restoration measures.
- Maintain the ability of agricultural land to support sustainable production.
- Use the best available science and appropriate baseline information.
- Where soil restoration is relevant, consider soil biological, physical and chemical characteristics rather than relying on a single indicator.
- Connect restoration measures with the wider landscape and avoid creating isolated areas of restored habitat.

2. Improve agricultural ecosystem indicators

The target is to increase the national trend of at least two of three indicators until satisfactory levels, as defined in the NRPs, are reached:

1. grassland butterfly index;
2. stock of organic carbon in cropland mineral soils; and
3. share of agricultural land with high-diversity landscape features.

These indicators provide different measures of biodiversity and ecosystem condition across agricultural landscapes.

How to achieve — example measures

- Support biodiversity-friendly farming systems and practices that improve conditions for butterflies and other farmland species.
- Maintain and restore high-diversity landscape features.
- Improve soil organic carbon through appropriate soil and crop management.
- Improve ecological connectivity between landscape features and semi-natural habitats.
- Use landscape-scale programmes rather than treating each indicator as a separate issue.
- Establish baseline conditions and monitor changes over time.

Pitfalls to avoid — specific DON'Ts

- Don't implement measures without establishing a baseline and a way of measuring whether they are working.
- Don't treat the three indicators as completely separate from one another.
- Don't rely on short-term observations to judge restoration success.
- Don't assume that increasing the area under a particular measure automatically means that biodiversity or ecosystem condition has improved.
- Don't restore elements or semi-natural areas without ensuring appropriate management regimes.
- Don't use a single soil indicator as a complete measure of soil health.

Important considerations — specific DO's

- Define indicators, target values and time horizons before implementation.
- Use consistent monitoring methods over time.
- Consider ecological, social and economic outcomes where relevant.
- Do retain, restore and connect high-diversity landscape features.
- Do implement measures as coordinated landscape mosaics, combining diverse crops, semi-natural habitats and structural features across farms.
- Monitor restoration outcomes rather than simply recording the number or area of measures implemented.
- Use adaptive management where monitoring shows that measures are not producing the expected results.
- Consider connectivity and landscape structure when interpreting changes in biodiversity indicators.

3. Increase the common farmland bird index

The target is to increase the common farmland bird index at national level to:

- 110/105 by 2030
- 120/110 by 2040
- 130/115 by 2050

The different numbers apply to Member States depending on whether their farmland bird populations have been historically more (lower number) or less (higher number) depleted.

Member States should achieve an increasing national trend in the common farmland bird index.

How to achieve — example measures

- Use biodiversity-friendly farming systems that provide food, nesting areas and shelter for farmland birds.
- Restore and maintain high-diversity landscape features.
- Improve connectivity between suitable habitats across agricultural landscapes.
- Reduce pressures affecting farmland bird populations.
- Integrate biodiversity measures with agricultural production rather than treating them as separate activities.
- Maintain a long-term monitoring programme for farmland bird populations.

Pitfalls to avoid — specific DON'Ts

- Don't measure success only by the area of agricultural land covered by restoration measures.
- Don't rely on isolated habitat patches that do not contribute to wider landscape connectivity.
- Don't rely on short-term monitoring to assess changes in bird populations.
- Don't focus on a single species or individual measure while overlooking wider pressures affecting farmland birds.

Important considerations — specific DO's

- Maintain long-term monitoring of the common farmland bird index.

- Plan restoration across the wider agricultural landscape.
- Work with farmers and land managers when designing and implementing measures.
- Consider the combined effects of agricultural practices, habitat availability and landscape connectivity.
- Use monitoring results to adapt measures where necessary.

4. Restore organic soils in agricultural use that constitute drained peatlands

Member States are required to implement restoration measures on:

- 30% of such areas by 2030, of which at least one quarter is rewetted;
- 40% by 2040, of which at least one third is rewetted; and
- 50% by 2050, of which at least one third is rewetted.

Member States are allowed to implement restoration measures, including rewetting, in peat extraction areas and count these towards the relevant targets. They may also rewet organic soils constituting drained peatlands under other land uses and count those areas towards the targets, up to the specified limit. Where rewetting is used, the water levels achieved should contribute to reducing greenhouse gas net emissions and increasing biodiversity, taking national and local circumstances into account.

The targets do not require individual farmers or private landowners to rewet agricultural land. Rewetting on agricultural land remains voluntary, without prejudice to national law.

Member States should, where appropriate, make rewetting an attractive option for farmers and landowners and provide access to training and advice on its benefits, subsequent land management and related opportunities.

How to achieve — example measures

- Rewet drained agricultural peatlands where this is appropriate to the local conditions and restoration objectives.
- Consider paludiculture — rewetting combined with harvesting biomass from crops grown under wet conditions — as one option for managing rewetted agricultural peatlands.
- Use rewetting to reduce greenhouse gas emissions and improve biodiversity while taking account of local hydrology and land-use conditions.
- Provide advice and training to farmers and landowners considering rewetting.
- Consider compensation or other incentives where investment is required to change land management.
- Support the development of markets for paludiculture products, including product development and market access across the value chain.
- Plan peatland restoration at landscape and catchment scale rather than treating individual parcels in isolation.
- Monitor water levels, greenhouse gas emissions, biodiversity and other relevant restoration outcomes.
- Coordinate restoration with other relevant policies and programmes.

Pitfalls to avoid — specific DON'Ts

- Don't treat rewetting as a one-size-fits-all intervention.

- Don’t assume that rewetting will automatically result in net carbon sequestration.
- Don’t treat paludiculture as equivalent to full ecological restoration.
- Don’t raise water levels without considering local hydrology and surrounding land uses.
- Don’t abandon drained peatlands without addressing the underlying drainage and greenhouse gas emissions.
- Don’t allow agricultural support mechanisms or other land-use incentives to work against restoration objectives.
- Don’t implement peatland restoration through separate, uncoordinated policy processes.
- Don’t rely on weak or incomplete monitoring of peatland condition and greenhouse gas emissions.
- Don’t treat restoration as a parcel-by-parcel intervention where hydrology and ecological processes operate across the wider landscape.

Important considerations — specific DO’s

- Plan peatland restoration at landscape and catchment scales.
- Make voluntary rewetting a practical and attractive option for farmers and landowners.
- Provide training and advice on rewetting, subsequent land management and related opportunities.
- Where appropriate, compensate farmers for investments associated with rewetting.
- Support paludiculture according to the same principles of sustainable agricultural land use.
- Develop markets for paludiculture products and support the full value chain from production through to processing and market entry.
- Monitor the effects of restoration rather than assuming that the chosen measure will deliver the intended outcome.
- Consider biodiversity, greenhouse gas emissions and land-use outcomes together.
- Coordinate the NRR with the Water Framework Directive, Birds and Habitats Directives, LULUCF and agricultural policy.
- Ensure that peatland emissions and condition are adequately represented in monitoring and national greenhouse gas accounting.

Evidence from practice

SHOWCASE

Showcasing synergies between agriculture, biodiversity and Ecosystem services

SHOWCASE created a network of 10 European Experimental Biodiversity Areas to research and promote biodiversity-friendly farming. The project worked with farmers to co-design practices, develop indicators and share knowledge, with the aim of supporting sustainable and profitable agriculture while delivering benefits for ecosystems and society: https://showcase-project.eu/about.

ARAGORN

ARAGORN supports land managers dealing with contaminated soils in urban, peri-urban and rural areas, with a focus on persistent contaminants and approaches to remediation and restoration: https://aragorn-horizon.eu/.

ProPollSoil

ProPollSoil examines the relationship between soil health and soil-dwelling pollinators and uses citizen science to support sustainable soil practices: https://cordis.europa.eu/project/id/101219108.

AGRI4POL

AGRI4POL promotes sustainable agricultural practices that benefit pollinators through the EU Common Agricultural Policy Network: https://cordis.europa.eu/project/id/101181146.

INSURE

INSURE examined wet management of cultivated peatlands as a potential sustainable land-use option. The research showed that rewetting can substantially reduce greenhouse gas emissions from drained peatlands, while paludiculture can allow biomass production to continue under wet conditions. The evidence also highlights the need to consider the differences between productive wetland use and full ecological restoration: https://projects.au.dk/ejpsoil/soil-research/insure.

EJP SOIL

EJP SOIL brought together European research on sustainable agricultural soil management, with work covering areas including soil organic carbon, soil structure, erosion and soil biodiversity. Its outputs include work on soil-health indicators and approaches for assessing soil condition: https://ejpsoil.eu/.

Forest Ecosystems (Article 12) and Planting 3 Billion Additional Trees (Article 13)

Article 12 focuses on restoring biodiversity in forest ecosystems (including managed forests) in addition to areas under Art. 4 (1), 4(4), and 4 (7) (e.g., Natura 2000 forest sites) and Article 13 on planting additional trees in the context of ecological restoration in forest areas, agricultural areas, rivers, and urban areas, in the EU.

Article 12 acts along three main objectives:

- improve biodiversity in (managed) forest ecosystems while taking into account the risk of forest fires;
- increase the national common forest bird index in forest ecosystems (including in managed forests); and
- improve at least six of seven forest ecosystem indicators incl. standing and lying deadwood, share of uneven-aged forests, forest connectivity, stock of organic carbon, share of forests dominated by native tree species, and tree species diversity.

Article 13 complements these objectives with the commitment to plant at least three billion additional trees at Union level by 2030 not only in forest areas, but also in restoration of agricultural, river and urban ecosystems. Tree planting under Article 13 is not just a numerical target. The NRR requires planting to follow ecological principles, including species and age-structure diversity, native tree species priority, ecological connectivity and sustainable approaches to afforestation, reforestation and tree planting, and the increase in urban green space.

1. Enhance biodiversity of forest ecosystems

The target is to improve the ecological condition and biodiversity of forest ecosystems (including in managed forests). Restoration planning should consider and prioritise:

- ecosystem processes, structures and functions;
- ecological connectivity;
- standing and lying deadwood;
- native tree species;
- species diversity;
- uneven-aged structure;
- stock of organic carbon, and
- forest ecosystem indicators that can demonstrate improvements in biodiversity.

The wider restoration framework also requires actions to be climate-resilient, address the pressures causing degradation and use appropriate, traceable and certified planting material.

How to achieve — example measures

- Increase the amount and diversity of standing and lying deadwood.
- Support forests with more varied age structures.
- Increase the share of forests dominated by native tree species where appropriate.
- Increase tree species diversity.
- Improve connectivity between forest areas.
- Restore forest structure and ecological processes rather than focusing only on tree numbers.
- Address the pressures responsible for degradation before or alongside restoration.
- Combine restoration with climate adaptation and other ecosystem objectives where appropriate.
- Use a landscape-scale approach where forest ecosystems and ecological processes extend beyond individual sites.

Pitfalls to avoid — specific DON'Ts

- Don't define forest restoration simply as planting more trees.
- Don't expand forest cover at the expense of valuable open habitats. In mosaic landscapes, forest restoration should be planned together with the conservation and restoration of grasslands and other open ecosystems.
- Don't rely on single-species planting where this reduces species diversity or structural complexity.
- Don't focus on one biodiversity feature while ignoring the wider forest ecosystem.
- Don't restore isolated forest patches without considering ecological connectivity.
- Don't introduce restoration material without appropriate biosecurity and traceability.
- Don't begin restoration without understanding the condition of the forest and the pressures affecting it.
- Don't assume that planting alone will restore forest ecosystem function.

Important considerations — specific DO's

- Use a clear baseline and define measurable restoration objectives.
- Consider forest structure, species composition, age diversity, deadwood and connectivity together.
- Consider disturbance and land-use history when defining the restoration trajectory, including previous planting, fire, grazing and abandonment where relevant.
- Retain or develop a diversity of forest structures and age classes.
- Prioritise native species where appropriate to the ecological context.
- Screen restoration actions against future climate and disturbance conditions.
- Engage landowners, forest managers, local communities and relevant experts early.
- Fund monitoring and adaptive management as part of the restoration project rather than as an afterthought.

2. Increase the common forest bird index

The target is to increase the trend at national level of the common forest bird index until the satisfactory levels established in the NRPs are reached.

The common forest bird index is one of the measures used to demonstrate whether biodiversity in forest ecosystems is improving.

How to achieve — example measures

* in line with ANNEX VII LIST OF EXAMPLES OF RESTORATION MEASURES REFERRED TO IN ARTICLE 14(16)

- Restore forest structures that provide a range of habitats for forest species.
- Avoid forest birds disturbance and killing through forest management incl. timber harvesting, plantations and other forest uses (e.g., recreation, infrastructure, renewables)
- Practice sustainable hunting of forest birds in line with the Birds and Habitats Directives.
- Enhance forest diversity by restoring mosaics of non-forest habitats such as open patches of grassland or heathland, ponds or rocky areas*
- Establish riparian buffers, such as riparian forests, buffer strips, meadows or pastures*
- Increase structural and age diversity.
- Maintain and increase deadwood where appropriate.
- Improve connectivity between forest areas.
- Increase the diversity of native tree species where this supports the restoration objective.
- Address the pressures responsible for declines in forest biodiversity.
- Monitor bird populations alongside the wider forest indicators.

Pitfalls to avoid — specific DON'Ts

- Don't treat the bird index as a target that can be addressed independently of forest condition.
- Don't focus only on tree cover or tree numbers.
- Don't create isolated restoration areas where connectivity is important.
- Don't rely on short-term changes to judge whether forest biodiversity is recovering.
- Don't overlook other pressures affecting forest ecosystems.

Important considerations — specific DO's

- Use the bird index alongside the wider forest ecosystem indicators.
- Consider habitat structure, food availability, nesting opportunities and connectivity as part of the wider restoration approach.
- Maintain consistent monitoring methods over time.
- Use monitoring results to adjust restoration and management where necessary.
- Consider the wider landscape when planning forest restoration.

3. Improve at least six of seven forest ecosystem indicators

The target is to increase the trend at national level of at least six of the following seven indicators until the satisfactory levels established in the NRPS are reached:

1. standing deadwood;
2. lying deadwood;
3. share of forests with uneven-aged structure;
4. forest connectivity;
5. stock of organic carbon;
6. share of forests dominated by native tree species; and
7. tree species diversity.

The indicators provide a way of measuring different aspects of forest ecosystem condition and biodiversity.

They cover:

- habitat structure;
- forest connectivity;
- carbon storage;
- native species composition; and
- tree species diversity.

The indicators should be selected on the basis of their ability to demonstrate enhancement of forest biodiversity within the Member State concerned.

How to achieve — example measures

* in line with ANNEX VII LIST OF EXAMPLES OF RESTORATION MEASURES REFERRED TO IN ARTICLE 14(16)

- Allow standing and lying deadwood to develop where appropriate.
- Increase ecological features in forests, such as large, old and dying trees (habitat trees) and amounts of lying and standing deadwood.*
- Increase structural diversity and uneven-aged forest structures.
- Make use of 'close-to-nature' or 'continuous cover' forestry approaches; introduce native tree species, and avoid intensive forestry practices (e.g., clear-cutting, monocultures, removal of whole trees and stumps, extensive use of "salvage logging")*
- Enhance the development of old-growth native forests and mature stands, for example, by abandonment of harvesting or by active management which favours development of autoregulatory functions and appropriate resilience.*
- Work towards a diversified forest structure in terms of, for example, species composition and age, enable natural regeneration and succession of tree species.*
- Adapt forests to climate change with priority for natural processes.
- Assist migration of provenances and species where it may be needed due to climate change.*
- Improve connectivity between fragmented forest areas.
- Support the development and regeneration of native tree species.
- Increase tree species diversity where appropriate.
- Protect and improve forest soil and organic carbon stocks.
- Use restoration measures that improve several indicators at the same time where possible.
- Establish a baseline for each relevant indicator and monitor changes over time.

Pitfalls to avoid — specific DON'Ts

- Don't treat the indicators as a checklist of unrelated targets.
- Don't improve one indicator at the expense of overall forest ecosystem function.
- Don't assume that increasing tree species numbers alone creates a biodiverse forest.
- Don't remove deadwood or simplify forest structure where these features contribute to biodiversity.
- Don't use restoration measures without monitoring whether the indicators are actually improving.

- Don't isolate forest restoration from wider landscape connectivity.
- Don't remove a large number of trees affected or expected to be affected by climate change disturbances (e.g., drought, storms, bark beetle, fires) in the name of tackling forest health issues ("salvage logging") as this affects nature restoration processes.
- Don't manage forests mainly for timber production business-as-usual and without leaving sufficient time for forests to naturally adapt to disturbances, without leaving a sufficient number of deadwood on the affected areas to support natural micro-conditions for survival, adaptation, and renewal.

Important considerations — specific DO's

- Use indicators that reflect the characteristics of the forest ecosystem concerned.
- Set clear baselines, target values and monitoring timeframes.
- Consider the relationships between indicators rather than managing each one separately.
- Maintain ecological connectivity between restored and existing forest areas.
- Consider carbon storage alongside biodiversity and forest structure.
- Use adaptive management when monitoring shows that restoration measures are not producing the expected results.
- Apply the general restoration safeguards on biosecurity, climate resilience, stakeholder engagement and monitoring.

4. Plant at least three billion additional trees by 2030 at Union level

Member States should ensure that their contribution is achieved in full respect of ecological principles. This includes:

- species diversity;
- age-structure diversity;
- prioritising native tree species;
- using non-native species only in very specific cases and conditions where they are adapted to the local soil, climatic and ecological context and can contribute to resilience to climate change;
- increasing ecological connectivity; and
- using sustainable afforestation, reforestation and tree planting.

The target can also be supported through increasing urban green space.

How to achieve — example measures

- Prioritise planting that restores or strengthens ecological connectivity.
- Use sustainable afforestation and reforestation where they are ecologically appropriate.
- Increase species diversity rather than relying on single-species planting.
- Develop varied age structures rather than creating uniform stands (monocultures).
- Prioritise native tree species suited to the local ecological context.
- Select planting locations based on restoration needs rather than simply identifying areas where trees can be planted.
- Integrate tree planting with wider restoration, forest management and urban green-space objectives.
- Use appropriate, traceable and certified planting material.
- Plan for the long-term management and survival of planted trees.

Pitfalls to avoid — specific DON'Ts

- Don't treat the three-billion-tree target as a simple tree-counting exercise.
- Don't equate trees planted with restoration success. Establishment, survival and contribution to ecological function matter more than planting numbers alone.
- Don't rely on single-species plantations to meet restoration or tree-planting objectives.
- Don't plant trees in locations where doing so would damage existing valuable ecosystems.
- Don't use unsuitable or poorly adapted planting material.
- Don't introduce potentially harmful pathogens through nursery stock.
- Don't plant without considering future climate and disturbance conditions.
- Don't assume that planting a tree automatically contributes to ecological restoration.

Important considerations — specific DO's

- Start with the ecological objective and identify whether tree planting is the appropriate measure.
- Use species and age diversity as part of the planting design.
- Prioritise native species and appropriate provenances suited to site conditions, restoration objectives and future climate.
- Consider ecological connectivity at landscape scale.
- Assess soil, climate and habitat conditions before planting.
- Assess nursery capacity before setting large planting targets, including availability, provenance, genetic diversity, propagation time and phytosanitary quality of planting material.
- Use certified, traceable and appropriately checked planting material.
- Include long-term management, monitoring and replacement requirements in project planning.
- Consider climate resilience from the outset.
- Where planting contributes to restoration, measure ecological outcomes rather than only the number of trees planted.

Evidence from practice

SUPERB (Systemic solutions for forest restoration and climate adaptation)

SUPERB brought together practical experience from successful and unsuccessful forest restoration and adaptation efforts with scientific knowledge on economics, governance, forest management and climate adaptation. The project established 12 large-scale demonstration sites across 12 countries. The sites represented wider socio-ecological systems and considered community needs, ecosystem services and benefits. Restoration was carried out with local communities, landowners and regional partners.

SUPERB generated practical and scientific knowledge across different forest types. One of its legacies is the Forest Knowledge Gateway, a continuously developing knowledge base containing practical resources on forest restoration, climate change adaptation and integrative forest management. https://forest-restoration.eu/

BIOCONSENT (Decision-making Support for Forest Biodiversity Conservation and Restoration Policy and Management in Europe: Trade-offs and Synergies at the Forest-Biodiversity-Climate-Water Nexus)

First, the project created five national policy maps (each for EU-27 countries) of five key EU forest biodiversity restoration practices in line with the EU's Nature Restoration Regulation objectives (Art. 12) based on content analysis of national policy and legal documents. The policy maps focussed on key

indicators such as (i.) allowance of clearcutting, (ii.) mandatory short-term reforestation, (iii.) deadwood retention, (iv.) forest set aside, and (v.) forest birds. This helped identify different types of policy (in-)coherence across EU level and six national and regional contexts (e..g, Bulgaria, Germany, Poland, Slovenia, Spain, and Sweden).

Second, significant differences in how EU forest biodiversity objectives are integrated into national forest policies were first explained by the dominance of production, environmental or multiple-use supportive policy advocacy coalitions of private and public actors, highlighting both synergies and trade-offs of biodiversity restoration with climate and economic goals. This was done through content analysis of policy documents (> 50) as well as by expert interviews and focus groups (>80), and participatory workshops (>70 participants).

Third, the (in)effectiveness of implementing EU forest biodiversity objectives was investigated through the differential behavioral responses of a variety of private forest owners and public forest managers (>1,800 respondents). The results show that “Multifunctionalists” consistently support EU biodiversity and climate objectives, while “Optimizers” tend to prioritize economic outcomes and often oppose EU regulations. “Environmentalists” display generally positive but context-dependent responses, whereas “Traditionalists” show more limited support, particularly for stricter conservation measures. Across countries, the presence of “Passive” forest owners indirectly supporting passive biodiversity restoration was also discussed.

Last, but not least, forest simulation models projected both trade-offs and synergies between biodiversity restoration, timber production and climate mitigation/adaptation under three alternative futures including “Biodiversity-first”, “Multifunctionality” and “Bioeconomy first” pathways, were identified. Altogether, BIOCONSENT work showed that future biodiversity outcomes depend on policy choices, the behavioural responses of forest owners and managers, and forest ecosystem characteristics. https://www.bioconsent.eu/

RESIPATH and relevant research

The BiodivERsA project RESIPATH (Responses of European Forests and Society to Invasive Pathogens) examined how European forest communities have been affected by invasive pathogens and approaches to mitigating their impacts.

RESIPATH and related national research demonstrated large-scale infestations of forest nursery plants and the subsequent spread of soilborne invasive Phytophthora pathogens into forests, woodlands and riparian ecosystems. The impacts included tree dieback and mortality, including decline and mortality affecting beech, oak and riparian alder forests.

The evidence highlights a significant restoration risk: infected nursery plants can introduce pathogens into ecosystems through restoration and tree-planting activities. (https://www.biodiversa.eu/2022/10/31/resipath/; Jung & Blaschke 2004; Jung 2009; Jung et al. 2016, 2018; Riddell et al. 2019; Green et al. 2021, 2025; Horta Jung et al. 2025)

CONCLUDING REMARKS

The *Getting Restoration Right Together* key takeaways:

- ➔ Start with a strong baseline: Assess ecological condition, degradation pressures and the wider ecological and social context before restoration.
- ➔ Address the pressures causing degradation: Remove or reduce the pressures affecting ecosystems rather than focusing only on restoration interventions.
- ➔ Restore whole ecosystems: Restore ecosystem structure and function rather than individual elements in isolation.
- ➔ Consider connectivity: Plan restoration at the landscape scale and consider connectivity between restored and existing areas.
- ➔ Consider future conditions: Design restoration measures to be resilient to climate impacts and future environmental conditions.
- ➔ Plan restoration from the outset: Consider assessment, planning, implementation, ongoing management and monitoring as part of the restoration process.
- ➔ Use adaptive management: Define indicators, target values and thresholds, monitor progress and adjust restoration measures where required.
- ➔ Use appropriate restoration materials: Ensure appropriate sourcing, sufficient genetic diversity, pathogen controls and traceability of seeds, plants and other biological material.
- ➔ Engage stakeholders and relevant expertise: Involve relevant stakeholders and scientific and technical experts in restoration planning and implementation.
- ➔ Define and measure success: Establish clear success criteria, scientifically backed monitoring schemes, standardised indicators and target values, including ecological and, where relevant, social and economic outcomes.

Identified opportunities for implementation support going forward:

- Defining satisfactory levels for the agricultural, forestry, and pollinator indicators set out in the Regulation, with a view to updating the plan in 2030 from a scientific and socio-economic perspective
- Defining the area targets to be covered by restoration measures in order to increase indicators reflecting the biodiversity of agricultural, forestry, and pollinator ecosystems, from a scientific perspective
- Defining favourable reference areas in greater detail according to ecological needs, taking into account future developments due to climate change
- Defining the socio-economic co-benefits (and costs) of ecosystem restoration, as well as climate co-benefits
- Enhancing the social acceptability of ecosystem restoration
- Causes and solutions for National Restoration Plan submission delays and barriers
- Causes for National Restoration Plan implementation barriers and associated knowledge, finance, skills and governance gaps

SUPPORTING RESOURCES

Nature Restoration Regulation Reference Portal: https://biodiversity.europa.eu/europes-biodiversity/nature-restoration/reference-portal-for-nature-restoration-regulation

BiodivRestore Knowledge Hub: Science-based guidance to implement the EU Nature Restoration Regulation: https://www.biodiversa.eu/engagement/biodivrestore-knowledge-hub/

Biodiversa+ The European Biodiversity Partnership supporting excellent biodiversity research with an impact on policy and society: https://www.biodiversa.eu/

BioAgora: https://bioagora.eu/

European Commission: Nature Restoration Regulation Supporting the restoration of ecosystems for people, the climate and the planet: https://environment.ec.europa.eu/topics/nature-and-biodiversity/nature-restoration-regulation_en

Ecologic Institute – Science and Policy for a Sustainable World: https://www.ecologic.eu/20592

IUCN EU Nature Restoration Regulation Briefing: https://iucn.org/resources/information-brief/iucn-eu-nature-restoration-regulation-briefing

The Law

Nature Restoration Regulation:

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32024R1991&qid=1722240349976

Nature Restoration Regulation Uniform Format (Annex1): https://eur-lex.europa.eu/eli/reg_impl/2025/912/oj/eng#tit_1