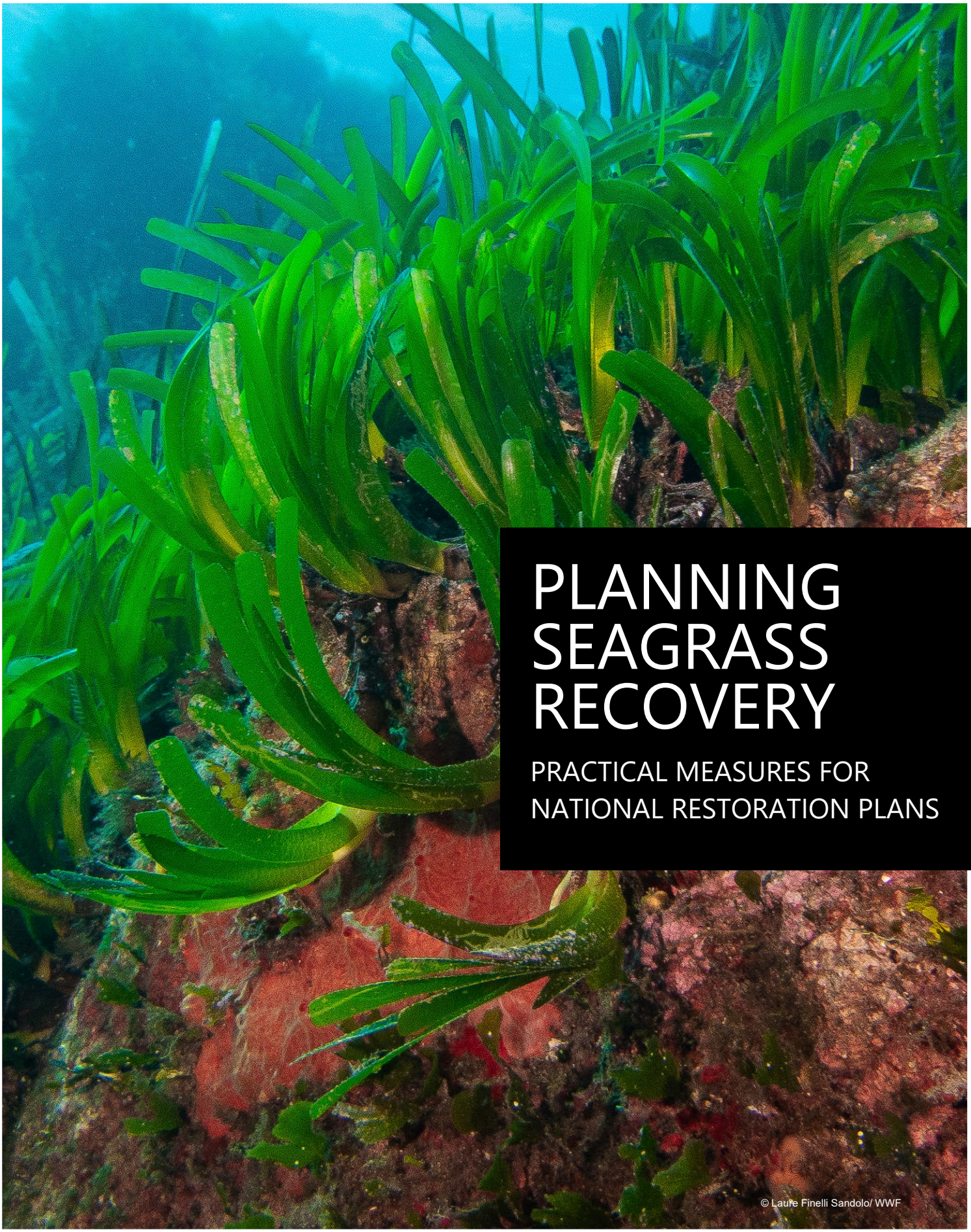


PLANNING SEAGRASS RECOVERY

PRACTICAL MEASURES FOR NATIONAL RESTORATION PLANS

Table of contents

Executive Summary 2
Glossary 3
Background 4
Policy Context 6
Mediterranean Seagrass Ecosystems: importance and threats 7
Roadmap Steps for Integrating Seagrass into National Restoration Plans 9
Conclusion 19
Key Recommendations 20
Acronyms 21
References 22
Useful resources 23
Acknowledgements 24

Executive Summary

Seagrass ecosystems, particularly *Posidonia oceanica* in the Mediterranean, are critical for biodiversity conservation, climate mitigation and adaptation, coastal protection, and water quality. Despite their high ecological and socio-economic value, these habitats have experienced substantial and long-lasting declines due to anchoring, bottom trawling, coastal development, pollution, and climate change. *Posidonia oceanica* is protected under the Habitats Directive as a priority habitat type. The more recent EU Nature Restoration Regulation (NRR) has created a legally binding framework that requires Member States to restore degraded marine habitat types. As a first step in its implementation, Member States must integrate marine habitat restoration, including seagrasses, into their National Restoration Plans (NRPs).

This report provides practical guidance to support national and regional authorities in effectively embedding seagrass protection and restoration into NRPs. It promotes a step-wise, evidence-based roadmap that prioritises pressure reduction and passive restoration, complemented by targeted active restoration only where necessary.

The report combines a review of scientific and policy sources with input gathered through a dedicated online event held on 30 April, 2026. The event was co-organised by the Mediterranean Posidonia Network (represented by WWF Mediterranean and OFB) and the European Commission's DG-ENV. It brought together 81 participants, including EU institutions, national and regional authorities, scientists, technical experts, stakeholders from non-EU Mediterranean countries, and members of the European Seagrass Restoration Alliance. Their feedback was integrated to ensure the guidance reflects shared priorities and practical needs.

Glossary

Natural or Passive restoration	An intervention strategy that involves reducing or eliminating the sources of degradation by acting on the activities generating the pressures and then allowing the ecosystem to recover spontaneously.	Restoration of coastal habitats in coastal marine environments. Technical Note. Office Français de la Biodiversité, 2024.
Reconstructive or Active restoration	An intervention strategy that involves reducing or eliminating the sources of degradation by acting on the activities generating the pressures and taking action on the abiotic and biotic components of the ecosystem through the reintroduction of a significant proportion of species assemblages (biota).	
Advanced Mooring System	Advanced mooring systems (AMS) have been designed specifically to have minimal impact on the seabed and provide an environmentally friendly alternative to traditional moorings or anchoring. The terms eco-moorings and AMS describe the same thing and can be used interchangeably.	UK Marine Management Organisation Natural England – LIFE ReMEDIES project
Favourable Reference Areas	Favourable reference area is the total area of a habitat type within a given biogeographical region or marine region at national level that is considered the minimum necessary to ensure its long-term viability. It should support the habitat type and its associated species, as well as all significant ecological variations within their natural range. The favourable reference area comprises the existing area of the habitat type. Where this is insufficient, it also includes the additional area necessary for the habitat type to be re-established.	EUR-Lex
Non-Deterioration Requirement	Under Article 6(2) of the EU Habitats Directive, Member States must take appropriate measures to prevent the deterioration of protected natural habitats and habitats of species within Special Areas of Conservation.	EUR-Lex

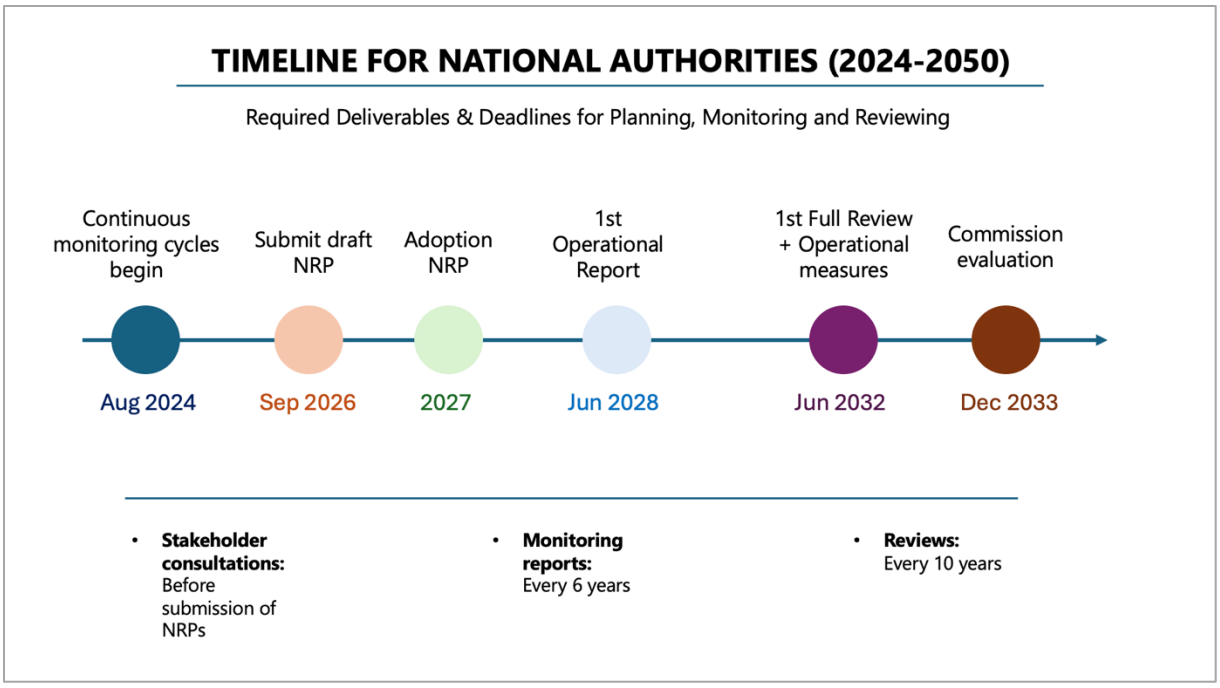
Background

The Nature Restoration Regulation (NRR) establishes legally binding targets for restoring degraded ecosystems across the EU's land and sea areas. Member States are required to submit national restoration plans (NRPs) that outline priority areas for habitat restoration, appropriate restoration measures and non-deterioration measures, actions to address knowledge gaps in the conditions of habitats, relevant timelines, financing arrangements and monitoring frameworks. The first drafts of these NRPs will have to be submitted by September 2026, followed by Commission assessment and finalization by September 2027. Seagrass habitats are central to the NRR's marine restoration objectives, given their role in biodiversity conservation, climate mitigation and adaptation, and coastal protection.

In the NRPs, Member States (MS) are required to address knowledge gaps on habitat extent and condition, define favourable reference areas, and prioritize restoration actions across marine habitat groups listed in its Annex II, with legally binding targets for the establishment of necessary restoration measures by 2030, 2040 and 2050. While there is significant flexibility for Member States to plan and prioritize restoration for more than 200 different habitats covered by the Regulation, *Posidonia oceanica* meadows are clearly a priority, considering their ecosystem role and benefits for climate and fisheries, among others. This has been underlined in the EU Biodiversity strategy for 2030.

Due to their slow growth rates and high sensitivity to pressures, *Posidonia oceanica* meadows require a specific restoration approach, combining strict protection, the reduction of cumulative pressures, and carefully targeted restoration measures. In addition to the obligation to restore *Posidonia oceanica* habitats that are not in good condition, the NRR's non-deterioration requirement is particularly important in the Mediterranean context, as it ensures that meadows in good condition, or restored to such condition, are maintained in good condition over time and are not further deteriorated while restoration measures are being designed. Where habitat recovery necessitates fisheries management measures, Article 18 of the NRR requires that the appropriate tools under the EU common fisheries policy (CFP) are used. Taken together, these provisions aim to ensure the long-term recovery and resilience of seagrass habitats, in synergy with existing legal provisions and international commitments.

The NRPs are developed through an iterative process involving competent national authorities, scientific bodies and relevant stakeholders, including sectors such as fisheries and spatial planning. Further guidance and relevant tools are available on the NRR Reference Portal hosted by the European Environment Agency. In November 2025 an implementation support event took place in Dublin to support MS authorities with the marine components of the NRPs. Discussions focused on existing knowledge gaps and data sources, condition assessment, links with the Marine Strategy Framework Directive (MSFD), methods to calculate the favourable reference area and appropriate restoration measures.


TIMELINE FOR NATIONAL AUTHORITIES (2024-2050)
Required Deliverables & Deadlines for Planning, Monitoring and Reviewing
Continuous monitoring cycles begin
Submit draft NRP
Adoption NRP
1st Operational Report
1st Full Review + Operational measures
Commission evaluation
Aug 2024
Sep 2026
2027
Jun 2028
Jun 2032
Dec 2033
• Stakeholder consultations: Before submission of NRPs
• Monitoring reports: Every 6 years
• Reviews: Every 10 years

Policy Context

Under the Habitats Directive, *Posidonia oceanica* meadows are listed in its Annex I and recognised as a priority habitat type, requiring MS to designate and effectively manage special areas of conservation (SACs) as part of the Natura 2000 network to contribute to achieving the favourable conservation status of this habitat type in their marine areas. In Natura 2000 sites designated for their protection, MS are obliged to establish conservation objectives and necessary conservation measures, as well as take steps to avoid deterioration of *Posidonia oceanica* meadows. This should already contribute a significant part of the required restoration measures under the NRR.

While the Habitats Directive focuses on the designation and protection of specific sites, the NRR requires MS to restore the areas of *Posidonia oceanica* that are currently not in good condition, including beyond Natura 2000 sites where relevant. In the Mediterranean, the NRR implementation should be coherent with existing regional frameworks, notably the Barcelona Convention, including the SPA/BD and ICZM Protocols, and the Strategic Action Programme for Biodiversity (SAP BIO), all of which recognize seagrass habitats, particularly *Posidonia oceanica*, as priority ecosystems for protection and restoration.

The implementation of seagrass restoration measures under the NRR should also be coordinated with other relevant EU policy frameworks. Improvements in water quality delivered under the Water Framework Directive (WFD) can directly support seagrass recovery by reducing nutrient inputs, pollution and turbidity. Similarly, the Maritime Spatial Planning Directive (MSPD) provides an important mechanism for allocating space for restoration and reducing user conflicts, while national Climate Change Adaptation Plans increasingly recognize seagrass meadows as a nature-based solution that enhances coastal resilience, reduces erosion and supports adaptation to climate change. Alignment with the Marine Strategy Framework Directive (MSFD) is equally important, as it provides the technical indicators needed to assess biodiversity and seafloor integrity (particularly D1 and D6) and to define Good Environmental Status (GES) in EU marine waters. MS should build on the monitoring programmes and programmes of measures established under the MSFD to support the development and implementation of their NRPs.

Although this report focuses on *Posidonia oceanica*, the roadmap has been developed as a scalable template that can be applied to other Annex II habitat types where information on distribution, extent and condition is currently insufficient. By providing a structured approach to mapping, monitoring, target setting, and restoration planning, it can support Member States in addressing key knowledge gaps. NRPs should, however, go beyond the consolidation of existing conservation obligations under the Habitats Directive and demonstrate a tangible added benefit for nature through new restoration actions, enhanced monitoring, dedicated funding, and measurable ecological improvements.

Mediterranean Seagrass Ecosystems: importance and threats

The Mediterranean Sea hosts various seagrass species, among which five are either native (C*ymodocea nodosa, Zostera marina*, *Zostera noltei* and *Ruppia maritima*) or endemic (*Posidonia oceanica*). In addition, two species, *Halophila stipulacea* and *Halophila decipiens* have been introduced to the region. The spatial distribution of these species is uneven across the Mediterranean, reflecting variations in environmental conditions, habitat types, and historical presence.

Of these species, *Posidonia oceanica* is recognized as the most ecologically significant due to its extensive distribution along Mediterranean coastlines (UNEP-MAP, 2010), its role in supporting biodiversity, and its contribution to coastal ecosystem functions. In the Mediterranean, *Posidonia oceanica* forms extensive meadows by covering an estimated 19,020 km^2 (Traganos et al., 2022) and can extend up to 40 meters in depth (Guerrero-Meseguer et al., 2017).

While the NRR addresses all seagrass species, this report focuses primarily on *Posidonia oceanica* due to its widespread distribution and key ecological role in the Mediterranean. Nevertheless, most recommendations presented in this document are also applicable to other seagrass species in the region.

According to scientific research (Capagne et al., 2015), *Posidonia oceanica* meadows provide at least 25 ecosystem services, including:

- Nursery, foraging grounds and habitat provision for commercially and ecologically important species
- Carbon sequestration and long-term storage (blue carbon)
- Coastal protection and sediment stabilization
- Water purification and nutrient cycling
- Water oxygenation
- Traditional use in agriculture and construction

The economic value of *Posidonia oceanica* meadows is not easy to measure. Various economic studies have provided different figures ranging from 500€ up to 500,000€/year/hectare. A 2024 French court of justice – Tribunal Maritime de Marseille (2024), FNE (2024) – related to the ecological prejudice caused by the impact of anchoring on *Posidonia oceanica* stated its economic value at 86,537€/year/hectare. It is also estimated that its economic value is three times greater than that of coral reefs, ten times greater than that of tropical forests and 100 times greater than that of a terrestrial meadow (Boudouresque et al., 2012).

Despite its socio-economic and environmental benefits, *Posidonia oceanica* has been fragmented and reduced in many coastal areas, due to notable transformation of coastal areas in recent decades brought about by urban, tourist, industrial, and agricultural developments along the Mediterranean coast. The anthropogenic impacts and accelerating climate change led to a 13-38% loss of *Posidonia oceanica* since 1960 (Marbà et al., 2014).

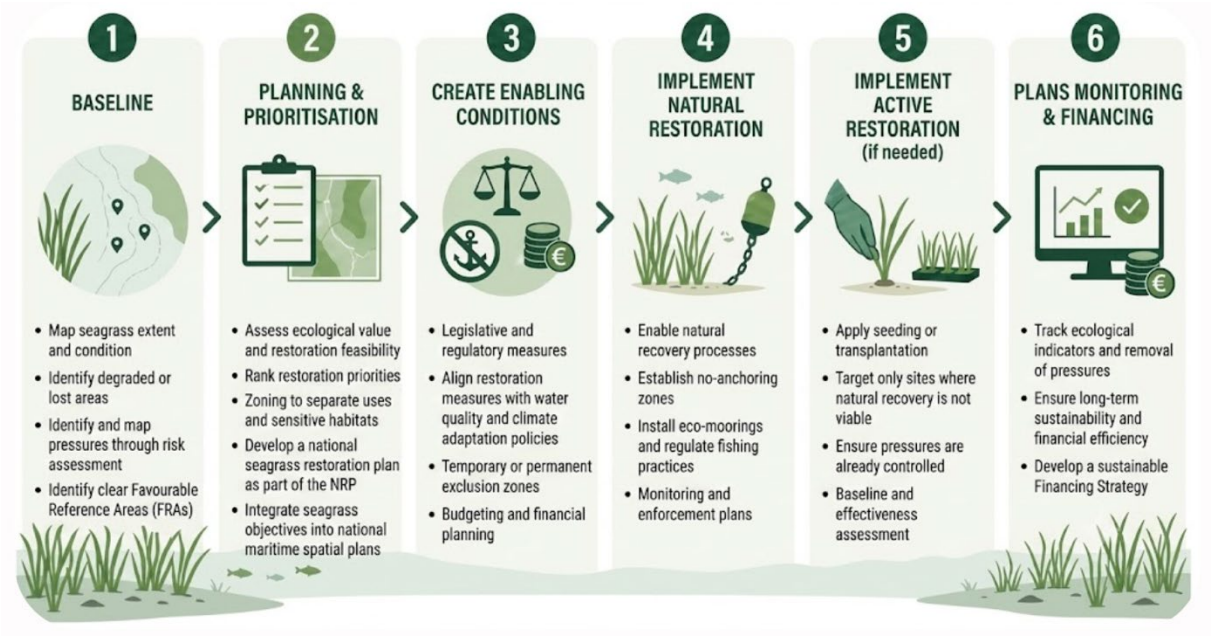
The key pressures that weaken the health and growth of *Posidonia oceanica* relate to the physical damage caused by anchoring, dredging, bottom trawling or coastal/harbour construction. As *Posidonia oceanica* is an extremely slow growing marine plant (~1-3 cm per year), this damage is usually permanent on a human timescale. Moreover, chemical pollution is another pressure that impedes the functioning of the plant. Sewage, waste from fish farms, excessive nutrients load, accumulation of toxic sulphides and heavy metals such as mercury, as well as desalinate brine, significantly impact *Posidonia oceanica* by, for instance, leading to up to 75% shorter plant leaves or an increase in oxidative stress markers (Capó et al., 2020). Additionally, biological threats from invasive species (particularly *Caulerpa cylindracea* and *Lophocladia trichoclados*) present a growing concern for *Posidonia oceanica* meadows, as they can cut young seedling biomass by 40-50% and disrupt their root systems, severely limiting the recovery of damaged meadows (Hendriks et al., 2026).

Finally, as the Mediterranean Sea is increasingly warming and experiences marine heatwaves, there are additional negative impacts on marine organisms and ecosystems. Research finds that the heat stress limit of *Posidonia oceanica* is 27°C above which the plant shows signs of reduction of leaves, changes in photosynthesis and in some cases even mortality (Guerrero-Meseguer et al., 2017).

Restoration is urgently needed to reverse these negative trends. The Nature Restoration Regulation, through its national restoration plans, represents a new opportunity to provide a comprehensive, structured and strong restoration plan for *Posidonia oceanica* and other seagrasses on national, regional and even sea-basin scales. To support coordinated efforts, the Mediterranean Posidonia Network (MPN) proposes a roadmap for integrating seagrass into national restoration plans.



Roadmap Steps for Integrating Seagrass into National Restoration Plans



Proposed Roadmap Steps for integrating Seagrass into NRPs.

Alignment with NRR key phases:

NRR Phase	Roadmap Contribution
Baseline assessment & target setting	Steps 1–2
Plan design & submission (by Sept 2026)	Steps 2–3
Implementation (2024 onward)	Steps 4–5
Monitoring & reporting (from 2024)	Step 6
Review & adaptive management (2032, 2033, every 10 years)	Steps 3–6

STEP 1

Baseline

NRR: Baseline assessment, reference conditions, target-setting

A robust baseline is essential to define restoration targets, assess feasibility, and meet NRR requirements on improving habitat condition and extent.
Sites for restoration should be prioritized based on environmental importance as well as feasibility (e.g. project maturity, governance, presence of a marine protected area, ease of enforcement).

Map seagrass extent and condition
Establish a national spatial baseline of seagrass meadows, covering current distribution, density, fragmentation, and condition/habitat state of conservation assessment (health status). Applying multi-method approaches should ensure accuracy and reproducibility. Ensure that knowledge gaps are closed at latest by 2040 as required by the NRR, and much before, if possible, while applying a precautionary approach.

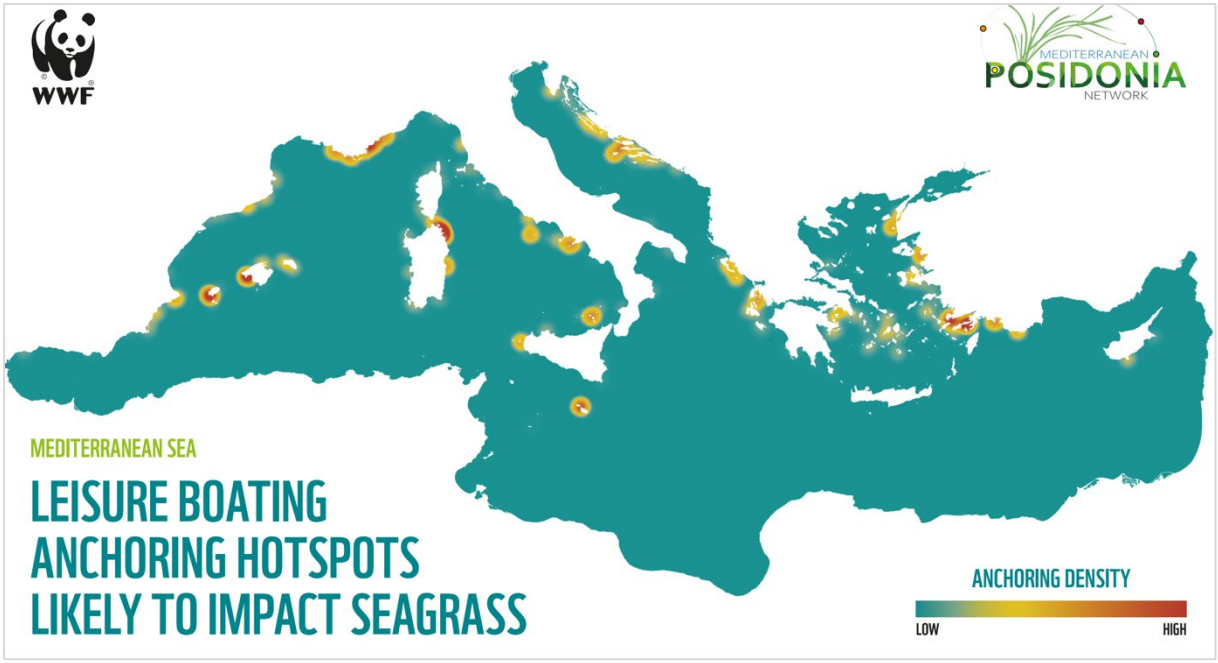
Identify degraded or lost areas
Quantify historical distribution and losses and degraded meadows (i.e. dead matte/living seagrass ratio) to define restoration potential, distinguishing between areas that can naturally recover and those requiring active intervention. When assessing historical losses and restoration potential, Member States should distinguish between seagrass decline caused by anthropogenic pressures and dead matte resulting from long-term natural processes. This is particularly important when defining restoration targets and favourable reference areas, to avoid planning restoration in areas that may no longer be environmentally suitable for seagrass recovery.

Identify and map pressures through risk assessment
Analyse and spatially map key pressures affecting seagrass, such as anchoring, bottom trawling, coastal development, pollution, turbidity, and eutrophication. This step directly informs prioritisation and enabling measures.
For this step, Member States should draw on the monitoring programmes under the Habitats, Water Framework and Marine Strategy Framework Directives and other relevant scientific work. If underwater field data to define the "good or bad state" of habitats is unavailable or requires further investigation, areas exposed to anthropogenic pressures known to potentially impact seagrass beds must be assumed to be degraded (precautionary principle).

Identify clear Favourable Reference Areas (FRAs)
Member States should define FRAs using historical data spanning at least 20 years, reflecting the approximate recovery period required by *Posidonia oceanica* to recover after destruction. Risk assessments should reflect and account for the ecological potential of habitats and provide a robust baseline for measuring the effectiveness of restoration projects, ensuring that the NRR implementation delivers measurable ecological improvements beyond existing policy obligations.

Illustrative examples:

- **Balearic Islands (Spain)**: Integrated aerial photography, side-scan sonar, ROV surveys, and GIS-based pressure mapping to guide anchoring bans, eco-mooring / advanced mooring system deployment, and restoration prioritization across Natura 2000 sites. Developed a participatory Posidonia Atlas as a public awareness and citizen-mapping tool through the Posidonia Surveillance Service.
- **POSEIDON Project (Sardinia, Italy)**: High-resolution underwater hyperspectral imagery (UHI) used to detect stressed *Posidonia oceanica* patches, allowing targeted management and intervention.
- **WWF Anchoring Pressure Report (Mediterranean-wide)**: 1 year of automatic identification system (AIS) data analysed to generate 100m-resolution anchoring pressure maps on seagrass, identifying regional hotspots and providing policy recommendations.



Anchoring pressure in the Mediterranean (from WWF's report *Safeguarding Mediterranean Seagrass Blue Forests from Anchoring Damage*, 2025).

STEP 2

Planning and prioritization

NRR: Restoration objectives, spatial prioritization, MSP coherence

This step translates baseline knowledge into strategic, spatially explicit restoration planning consistent with national biodiversity, climate, and marine strategies.

Assess ecological value and restoration feasibility
Evaluate sites based on ecological importance (carbon storage, biodiversity, coastal protection), climate suitability and resilience (to ensure long-term viability of recovered meadows under future climate scenarios), natural recovery potential, socio-economic constraints, and cost-effectiveness.

Rank restoration priorities
Use the above criteria to rank sites for:

- Natural restoration (pressure removal)
- Active restoration (only where recovery is unlikely without intervention and where natural restoration is in place, and controlled pressures have already been removed)

Zoning to separate uses and sensitive habitats
Define clear zones separating navigation corridors, anchoring areas, fishing grounds, and sensitive seagrass habitats to reduce conflict and cumulative impacts.

Develop a national seagrass restoration plan as part of the NRP
Consolidate targets, priority sites, measures, timelines, and indicators into a national seagrass component of the NRP, while ensuring coherence with other countries.

Integrate seagrass objectives into national maritime spatial plans
Align seagrass restoration targets with maritime spatial plans, reinforcing long-term protection and preventing new pressures. Restoration priority areas and high-potential sites should act as core ecological inputs for ecosystem-based MSP, guiding early spatial allocation and the definition of navigation corridors, anchoring zones and exclusion areas in line with the NRR's non-deterioration requirements.

STEP 3

Create the enabling conditions for successful restoration

NRR: Pressure reduction, prevention of deterioration, governance & financing

Restoration will fail if the underlying drivers of degradation are not addressed. This step focuses on systemic pressure reduction and governance.

Legislative and regulatory measures
Adopt or strengthen national and sub-national regulations to minimize pressures, ensuring compliance with NRR non-deterioration requirements and natural restoration requirements. These should be established on a wide spatial scale to ensure adequate progress towards NRR targets and compliance with non-deterioration requirements.
Additionally, to prevent bureaucratic bottlenecks from hindering restoration timelines, NRPs should define clear coordination mechanisms between local, regional and national authorities. Streamlining permitting processes and harmonizing administrative competencies are essential to ensure that such delays do not stall restoration projects.

Align restoration measures with water quality and climate adaptation policies
Restoration planning should be coordinated with WFD river basin management measures and national climate adaptation strategies. Improvements in wastewater treatment, pollution control and catchment management can substantially increase the potential for passive restoration. Seagrass meadows also provide important coastal protection benefits by reducing wave energy, stabilising sediments and helping to maintain beaches, making them valuable nature-based solutions for climate adaptation.

Temporary or permanent exclusion zones
Establish spatial restrictions tailored to site conditions, particularly effective for:

- Early-stage recovery areas
- Meadow edges and fragmented patches
- Historically impacted zones

Possible measures to designate exclusion zones include:

- Anchoring bans or regulated anchoring zones
- Fisheries restrictions (effective implementation of prohibition of fishing methods affecting habitats condition through effort limitation)
- New or strengthened MPAs (strict protection) and/or Natura 2000 sites

These are also natural restoration measures (see below), but here we look at them as enabling conditions (i.e. mechanisms to designate exclusion zones).

Budgeting and financial planning
Identify the financial needs for investment and functioning, and allocate dedicated budgets within NRPs, covering:

- Mapping and monitoring
- Effective enforcement
- Restoration measures
- Long-term maintenance of restoration areas (at least 10 years)

Illustrative examples:

- **French Mediterranean coast**: WWF-supported eco-mooring strategies (Fontcuberta A., Piante C., 2025) embedded in regulatory frameworks adopted by local authorities.
- In France, new coastal developments are generally not permitted within 20 metres of *Posidonia oceanica* meadows (Astruch et al., 2026). Where appropriate, planning tools such as buffer zones around seagrass meadows can be used to reduce impacts from coastal infrastructure and other developments.



Eco-mooring area in the Calanques National Park, France.

STEP 4

Identify, select and implement natural restoration measures

NRR: Restoration actions, non-deterioration duty, early reporting

Natural restoration focuses on allowing natural recovery once pressures are removed, often delivering the highest return on investment (Artemis, 2025).

Key natural restoration measures

- Designation or strengthening of protected areas (including strict protection)
- Anchoring bans and regulated anchoring zones
- Installation of eco-mooring fields / advanced mooring systems
- Fishing bans or gear restrictions
- Protecting seasonal swimming areas or recreational areas, including *Posidonia oceanica,* from other pressures and threats
- Control of stressors (e.g. invasive alien species (IAS) removal)
- Removal of coastal development pressures on *Posidonia oceanica* before planning permission is granted through implementation of Marine Spatial Plans defining areas where it is forbidden to build new infrastructure (e.g. in France there is a 20 m distance between *Posidonia oceanica* beds and allowable new developments).
- Removal of coastal development pressures on *Posidonia oceanica* after planning permission is granted through effective Environmental Impact Assessment (EIA) processes designed to protect *Posidonia oceanica* rather than compensate for losses.

Monitoring and enforcement plans

Ensure measures are reliable and effective through:

- Regular compliance checks
- Clear responsibilities across authorities
- Integration with existing MPA management structures

STEP 5

Identify, select and implement active restoration (if needed)

NRR: Targeted restoration where natural recovery is insufficient

Active restoration should be **site-specific, evidence-based, and complementary**, not a substitute for pressure reduction.

Guidance and standards
Apply recognized Mediterranean guidance, ensuring consistency and scientific robustness:

- **Mediterranean Posidonia Network** guidelines
- **MEDPAN GEF Project** methodologies

Selection of techniques
Choose methods based on site conditions and feasibility:

- Reintroduction/Transplantation (e.g. cutting, sods, clumps)
- Seeding approaches (e.g. spreading or growing in nurseries)
- Substrate/Site stabilization (e.g. mats, sandbags)

Baseline and effectiveness assessment
Use established baseline and monitoring methodologies (e.g. **ARTEMIS project**) to demonstrate ecological gains and justify cost-effectiveness under NRR reporting.



Seagrass monitoring in the Mediterranean.

STEP 6

Plans monitoring and financing

NRR: Reporting, review, adaptive management

Long-term success depends on continuous monitoring, reporting, and sustainable financing that prioritizes high-impact, cost-effective measures.

Track ecological indicators and removal of pressures
Monitor ecological and pressure indicators aligned with NRR requirements, such as:

- Areal extent and distribution
- % of pressures removed
- Shoot density and bottom cover
- Connectivity and fragmentation
- Associated biodiversity

Reporting obligations in the NRR
Data should be integrated into national cycles to allow for adaptive management:

- **Three-year progress reports (from 2028)**: focused on implementation of measures and early recovery signals;
- **Six-year monitoring reports (from 2031)**: providing a comprehensive assessment of habitat condition and extent

Develop a sustainable Financing Strategy
NRPs should provide for diverse and reliable funding streams to prevent gaps in monitoring resulting from insufficient resources, ensuring data continuity and supporting the demonstration of restoration success.

Combine:

- **National and EU public funding:** national environmental budgets and EU instruments (e.g. LIFE, EMFAF, HORIZON Europe) for large-scale measures and mapping
- **Private and Innovative Finance:** blue carbon or biodiversity credits schemes, particularly for natural restoration and large-scale measures
- **Fee-based Revenues:** implement fee-based mechanisms, such as eco-mooring / advanced mooring charges, pollution levies on wastewater utilities or tourism taxes, to fund meadow monitoring and enforcement activities.

Illustrative example:

- **Balearic Islands tourism taxes:** In 2016, the Balearic Government introduced a tourist tax on overnight stays ranging from between €1-€4.40/person/night in high season. Revenues are channelled into a Sustainable Tourism Fund that supports environmental protection, heritage conservation, and sustainable tourism initiatives, including *Posidonia oceanica* protection and habitat restoration projects.

Environmental and social integrity safeguards should be established for all funding mechanisms – particularly private and innovative finance – to ensure that restoration finance genuinely supports ecological recovery rather than being used to offset or justify continued habitat degradation.

Financial efficiency
Authorities should evaluate the return of investment (ROI) of different restoration approaches:

- **Cost effectiveness comparison:** Active restoration generally involves higher costs than natural restoration. However, methods such as seed sowing are considered among the most effective and cost-efficient active restoration techniques.
  Natural restoration, by comparison, is less resource-intensive, causes fewer environmental disturbances, and can deliver cost-effective outcomes where natural recovery conditions are favourable.
- **Scaling the gains:** While active restoration is usually limited to few hundred or thousand m^2, natural restoration (through stressor removal) can enable recolonization at a scale of several hectares per year at a bay level (Austruch et al., 2026), providing a vastly superior financial ROI.
- **Fund water infrastructure as a restoration investment:** Large scale public infrastructure projects such as upgrading water treatment plants can directly support ecosystem restoration by improving water quality, addressing the root causes of degradation and enabling the natural recovery of seagrass meadows.

Illustrative example:

- **Prado Bay (Marseille, France):** Combined wastewater treatment, industrial regulation, and legal protection of *Posidonia oceanica* led to recovery of between 47-94% of meadow cover in the period 1986-2025 (Astruch et al, 2026).

Conclusion

The implementation of the Nature Restoration Regulation introduces a significant shift toward legally binding recovery of Mediterranean seagrass ecosystems, requiring Member States to move beyond localized site protection to a comprehensive, sea-basin scale restoration framework integrated into their National Restoration Plans. This shift should be accompanied by clear governance arrangements, defined timelines, and assigned responsibilities at national and transboundary levels to ensure coordinated delivery.

The proposed roadmap underscores that restoration success largely depends on the reduction of key pressures – especially physical damage from anchoring and bottom trawling, as well as eutrophication – to create the necessary enabling conditions for recovery. Priority actions should include enforceable spatial measures, targeted pollution controls, and a schedule for phasing out damaging practices, supported by compliance monitoring and sanctions where needed. Concretely, the roadmap prioritizes a hierarchy of intervention that favours passive restoration measures, such as the enforcement of anchoring bans, the installation of eco-mooring fields/advanced mooring systems, and the upgrading of wastewater infrastructure; these methods have demonstrated a vastly superior financial return on investment by enabling natural recolonization at the scale of several hectares per year compared to the limited reach of manual interventions.

Active restoration techniques, including seed sowing or transplantation, should be viewed as complementary, site-specific tools utilized only when natural recovery is unfeasible and pressures are fully mitigated. All interventions should be guided by baseline assessments, standardized monitoring protocols, and adaptive management loops to evaluate effectiveness and scale up successful approaches.

To ensure long-term resilience, these objectives should be technically integrated into MSP to prevent future deterioration and aligned with the WFD to maintain water quality. Integration should also extend to fisheries management, coastal planning, and climate adaptation strategies to address cumulative impacts and future stressors.

Fulfilling NRR reporting obligations requires securing diverse and sustainable financing streams – ranging from innovative blue carbon credits to fee-based revenues – to support the continuous monitoring and adaptive management necessary to achieve measurable ecological gains through the 2030, 2040, and 2050 milestones.

Key Recommendations

1. **Establish a national baseline** by mapping seagrass meadows using cost-effective methods and developing risk assessment maps that evaluate pressures, threats, severity and likelihood of risk occurrence. Provide a credible plan for closing the knowledge gaps about habitat extent and condition by 2040 at the latest.

2. **Identify priority and compromised areas** through restoration planning maps, categorized by ecological conditions and the level of management or restoration intervention required.

3. **Remove or reduce pressures before restoration**, including through establishing and enforcing anchoring bans and other measures that prevent further damage to seagrass meadows.

4. **Prioritize natural restoration approaches**, such as no-anchoring zones, eco-moorings/advanced moorings, sewage treatment systems, nutrient reduction and effective MPAs.

5. **Ensure effective implementation and enforcement** of existing protection, management, and conservation measures.

6. **Apply active restoration only when necessary**, and only once pressures are effectively managed and natural recovery is not feasible, and use control zone to assess restoration efficiency in line with the MPN guidance.

7. **Establish robust monitoring frameworks** with clear indicators, baselines, targets and milestones to track recovery and effectiveness. Complement this with technical collaboration mechanisms for monitoring and mapping, and support for emerging researchers.

8. **Quantify full restoration and protection costs**, including mapping, enforcement, monitoring, governance, and long-term management of seagrass habitats.

9. **Integrate seagrass protection and restoration measures into MSP plans** and relevant sectoral policies, to enable more effective delivery of the NRPs.

10. **Ensure sound governance**, including strong permitting standards, safeguards, and stakeholder engagement and compliance strategies, supported by networks such as the MPN for sharing best practices and technical guidance.

Acronyms

AIS	Automatic Identification System
AMS	Advanced Mooring System
BarCon	Barcelona Convention
CFP	Common Fisheries Policy
EIA	Environmental Impact Assessment
FRA	Favourable Reference Area
GES	Good Environmental Status
IAS	Invasive Alien Species
ICZM	Integrated Coastal Zone Management
MPA	Marine Protected Area
MPN	Mediterranean Posidonia Network
MS	Member State(s)
MSFD	Marine Strategy Framework Directive
MSP	Maritime Spatial Planning
MSPD	Maritime Spatial Planning Directive
NRP	National Restoration Plan
NRR	Nature Restoration Regulation
ROI	Return on Investment
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SAP BIO	Strategic Action Programme for Biodiversity
WFD	Water Framework Directive

References

ARTEMIS Interreg Euro-MED Project, Ecoacsa, & EY Denkstatt. (2025). Investment opportunities in seagrass restoration: State-of-the-art summary. MEDSEA Foundation. https://artemis.interreg-euro-med.eu/wp-content/uploads/sites/68/sota-summary/artemis-sota-summary.pdf

Astruch, P., Boudouresque, C.-F., Ferrando-Demange, J., Belloni, B., Charbonnel, É., Gravez, V., & Schohn, T. (2026). Passive restoration of a Mediterranean Posidonia oceanica seagrass meadow: A 40-year survey. Marine Environmental Research, 217, 107965. https://doi.org/10.1016/j.marenvres.2026.107965

Boudouresque, C.-F., Bernard, G., Bonhomme, P., Charbonnel, E., Diviacco, G., Meinesz, A., Pergent, G., Pergent-Martini, C., Ruitton, S., & Tunesi, L. (2012). Protection and conservation of Posidonia oceanica meadows. RAMOGE and RAC/SPA publisher, Tunis: 1-202. https://www.rac-spa.org/sites/default/files/doc_vegetation/ramoge_en.pdf

Campagne, C. S., Salles, J-M., Boissery, P., & Deter, J. (2015). The seagrass Posidonia oceanica: Ecosystem services identification and economic valuation of goods and benefits. Marine Pollution Bulletin, 47(1-2), 391–400.

Capó, X., Tejada, S., Ferriol, P., Pinya, S., Mateu-Vicens, G., Montero-González, I., Box, A., & Sureda, A. (2020). Hypersaline water from desalination plants causes oxidative damage in Posidonia oceanica meadows. Science of the Total Environment, 736, 139601. https://doi.org/10.1016/j.scitotenv.2020.139601

Fontcuberta, A., & Piante, C. (2025). Protecting 100% of Posidonia seagrass meadows in the Mediterranean by 2030 – Toolkit for the establishment of eco-mooring areas for recreational vessels under 24 metres. WWF, Marseille, 50 pages.

France Nature Environnement (FNE) PACA. (2024, November 22). Reconnaissance du préjudice écologique sur les herbiers de posidonie. https://fnepaca.fr/system/files/inline-files/20241122%20Posidonie.pdf

Guerrero-Meseguer, L., Marín, A., & Sanz-Lázaro, C. (2017). Future heat waves due to climate change threaten the survival of Posidonia oceanica seedlings. Environmental Pollution, 230, 40–45. https://doi.org/10.1016/j.envpol.2017.06.039

Hendriks, I. E., Máñez-Crespo, J., van de Ven, C. N., Fitzpatrick, R. S., Borges, A. V., Champenois, W., Aires, T., Engelen, A. H., Muyzer, G., Vonk, J. A., & Tomas, F. (2026). Invasive macroalgae exert stronger effects than elevated CO_2 on seagrass *(Posidonia oceanica*) seedling performance and associated microbiomes. *Marine Pollution Bulletin, 233*(1), 120063. https://doi.org/10.1016/j.marpolbul.2026.120063

Marbà, N., Diaz-Almela, E., & Duarte, C. M. (2014). Mediterranean seagrass (*Posidonia oceanica*) loss between 1842 and 2009. Biological Conservation, 176, 183–190. https://doi.org/10.1016/j.biocon.2014.05.024

Restoration of coastal habitats in coastal marine environments. Technical Note. Office Français de la Biodiversité, 2024.

Traganos, D., Lee, C. B., Blume, A., Poursanidis, D., Čižmek, H., Deter, J., Mačić, V., Montefalcone, M., Pergent, G., Pergent-Martini, C., Ricart, A. M., & Reinartz, P. (2022). Spatially explicit seagrass extent mapping across the entire Mediterranean. Frontiers in Marine Science, 9, 871799. https://doi.org/10.3389/fmars.2022.871799

Tribunal maritime de Marseille. (2024, November 22). Destruction d'herbiers de posidonie : Sanctions pénales de capitaines et préjudice écologique. Observatoire des droits marins. https://www.obs-droits-marins.fr/_bibli/articlesPage/642/docs/tribunal-maritime-de-marseille-22-novembre-2024.pdf

United Nations Environment Programme - Mediterranean Action Plan - Regional Activity Centre for Specially Protected Areas (UNEP-MAP-RAC/SPA). (2010). Action Plan for the conservation of marine vegetation in the Mediterranean Sea. https://www.rac-spa.org/sites/default/files/doc_cop/biodiversity.pdf

Useful resources

ARTEMIS PROJECT

- Policy recommendations for Accelerating the Restoration of Seagrass Meadows in the Mediterranean area through Innovative ecosystem-service based Solutions

Fontcuberta, A. and Piante, C. (2025). *Protecting 100% of posidonia seagrass meadows in the mediterranean by 2030 – toolkit for the establishment of eco-mooring areas for recreational vessels under 24 metres*, WWF, Marseille, 50 pages.

Pergent-Martini C. et al., 2024. Guidelines for Posidonia oceanica restoration. Report Cooperation agreement Mediterranean Posidonia Network (MPN), French Biodiversity Agency (OFB) & University of Corsica Pasquale Paoli (UCPP) N°OFB-22-1310:
29 p. + Appendices. http://dx.doi.org/10.13140/RG.2.2.26679.84644

POSEIDON PROJECT

POSIDONIA ATLAS

Randone et al. (2025). *Safeguarding Mediterranean seagrass Blue Forests from anchoring damage*. WWF Mediterranean Marine Initiative (MMI).

Acknowledgements

This report would not have been possible without the expert preparatory work and inputs of Eva Sahores (OFB), Frédéric Villers (OFB), Marcial Bardolet (Instituto Balear de la Natura/IBANAT), Luca Jendrek (Instituto Balear de la Natura/IBANAT), Zjelka Rajkovic, Maddalena Visser (DG-ENV), Vedran Nikolic (DG-ENV), Anna Cheilari (DG-ENV), Guillaume Leport (Blueseeds), Arnaud Terrisse (Plan Bleu), Valentina Ceballos (WWF Mediterranean), Lynne Barratt (ELMEN).

Authors: Written and edited by Eider Graner and Mauro Randone (WWF Mediterranean Marine Initiative), within the framework of the Mediterranean Posidonia Network (MPN).

Citation of this report: *Planning Seagrass Recovery: Practical Measures for National Restoration Plans*, 2026. Mediterranean Posidonia Network.

Any reproduction in full or in part must mention the title and credit the above mentioned authors.

This work has been supported by the Med Blue Forests and Blue South Med projects.


MEDITERRANEAN
POSIDONIA
NETWORK

RÉPUBLIQUE
FRANÇAISE
Liberté
Égalité
Fraternité

OFB
OFFICE FRANÇAIS
DE LA BIODIVERSITÉ

WWF

NATURA 2000

European
Commission