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Agenda Item 3: Steps undertaken towards the implementation of the Post-2020 Strategic Action Programme for the Conservation of Biodiversity and Sustainable Management of Natural Resources in the Mediterranean Region (Post-2020 SAPBIO) at regional and national levels

Draft Guidelines to develop species recovery plans and implement emergency actions

SPA/RAC
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Acronym list

CBD	Convention on Biological Diversity
EU	European Union
FAO	United Nations Food and Agricultural Organization
GFCM	General Fisheries Commission for the Mediterranean and Black Sea
IUCN	International Union for Conservation of Nature
MedFund	Environmental Fund for Mediterranean Marine Protected Areas
MedPAN	Mediterranean MPA managers' network
MoU	Memorandum of Understanding
MPAs	Marine Protected Areas
MSFD	EU Marine Strategy Framework Directive
MSP	Marine Spatial Planning
NBSAPs	National Biodiversity Strategies and Action Plans
NGO	Non-governmental organisation
NRL	Nature Restoration Law
OECM	Other Effective areas-based Conservation Measures
PVA	Population Viability Analysis
QSR	Quality Status Report in the Mediterranean (UNEP/MAP 2017)
RFMO	Regional Fisheries Management Organisation
RSP	Regional Seas Programme (UNEP)
SAPBIO	Strategic Action Programme for the Conservation of Biological Diversity in the Mediterranean Region (2004-2018)
SCBD	Secretariat of the Convention on Biological Diversity
SCP	Strategic Conservation Planning
SDGs	United Nations Agenda 2030 Sustainable Development Goals
SER	Society for Ecological Restoration
SMART	Specific, Measurable, Achievable, Relevant and Time-bound
SPA/BD	Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (Protocol to the Barcelona Convention)
UfM	Union for the Mediterranean
UN	United Nations
UN Ocean Decade	United Nations Restoration Decade of Ocean Science for Sustainable Development
UNEP	United Nations Environment Programme
VME	Vulnerable Marine Ecosystems (of FAO)
WWF	World Wide Fund for Nature

How to use these guidelines

Species recovery planning requires a structured approach. The following sections are ordered in sequence of how a recovery plan should be approached, although one might go back and forwards between sections while drafting a plan. Each section provides best practice advice and current insights from conservation experts on how to approach species recovery and restoration. Blue boxes define key terms. Orange boxes refer to sources of further information on particular subjects. Pink boxes present key considerations for each step of the process or summarise key aspects. Green boxes bring the content of the section into a Mediterranean context. These guidelines should help countries to understand the requirements and parts of a recovery plan and thereby guide the drafting process, support implementation, and help to create the required administration.

Executive summary

1. Looking forward into the next decade, marine species recovery will require a trans-disciplinary approach with skills drawn from modelling, ecology, chemistry, social sciences, economics, finance, project planning, governance, and integrated land -sea spatial planning and management.

2. The complexity of marine ecosystems due to its dynamic nature, increasing use and expanding pressures, makes recovery planning a difficult and resourceful undertaking. However, guidance on all aspects of species and nature recovery is available and successful methods are emerging. Growing research into species and habitat recovery provides new tools, techniques and methods for recovery.

3. The guidelines present each step of recovery planning wit key considerations and questions to be answered along the way. Some examples and further information are presented in the individual sections. A recovery plan does not have to be a single document, but more so a combination of plans and processes that contribute to the achievement of an overarching vision. Multiple steps have to be conducted before a plan can be drafted and the drafting process is a dynamic undertaking as several parts depend on and inform each other.

4. Rebuilding marine life is a long-term but achievable goal, contingent on a global commitment to reduce pressures and enhance conservation efforts. However, it requires a combination of efforts and activities, both passive and active, to achieve habitat and species recovery [13].

5. The guidelines provide insights into legal obligations and existing policies for nature recovery before heading into pre-planning considerations and the steps of developing a recovery plan. Throughout the planning, it is important to consider all stakeholders and interests, as species recovery is not the sole responsibility of one entity or government, but a collaborative process with shared responsibilities that requires multiple resources and expertise along the way. The overarching aim of a recovery plan should be for the species to move away from a threatened status to a stable population that is supported by a healthy marine environment.

1. Introduction to species recovery and emergency actions

1. Marine nature recovery is a growing field and although species recovery plans have been around for decades, there is an increasing and improved understanding of how to do better, for both species and habitat restoration. With this comes ample advice, guidance and examples from the wider community of international institutions, expert groups, governments, researchers, and conservation managers. The United Nations Decade on Ecosystem Restoration emphasizes the need for a coordinated effort and approach for restoration which encompasses contributions from multiple stakeholders and disciplines.

2. Coastal and marine ecosystems and species are crucial but have gained lesser attention than terrestrial restoration efforts, apart from experiences in fish stock management and recovery. With increasing research and technological advances there are new and emerging methods for marine species recovery and habitat restoration. The distinction between passive (allowing ecosystems to recover naturally) and active (human-mediated) restoration highlights the varying approaches to marine ecosystem recovery. However, in all these efforts climate change is a factor that needs to be considered, not only in form of adaptive management, but also considering recovery success and changing baselines. Such success should be communicated not only in terms of species or habitat improvements but also considering the wider community and economic benefits. It is important to also learn from experience from both successful examples and failures and share knowledge.

3. Financial, social and political barriers need to be understood in the context in which the recovery plan operates. New financial schemes are emerging to support nature restoration, and this means that public funding must not be the sole source for actions. In fact, nature recovery should be a collective effort with shared responsibilities.

4. A good restoration plan needs to consider all these aspects across the different phases of species and habitat recovery.

1.1. Definitions

5. The aim of these guidelines is to assist Mediterranean countries in the development of national recovery plans for threatened species and those requiring management interventions, as listed under the SPA/BD Protocol Annex II and III respectively. But before going into the details of species recovery planning, it is important to define some key terms [2].

6. So, what does nature or species recovery mean? It is important to highlight here, that the focus of this document is on species, especially those listed on Annex II and III of the SPA/BD Protocol. However, some of the species listed in Annex II and III form habitats and some heavily depend on them, so recovery or restoration approaches should cover both species and their habitats [3].

Recovery planning *refers to the process of developing a recovery plan in alignment with the principles of Systematic Conservation Planning (SCP) and available best practice advice. Adopted from Nelson et al. (2023)*

Systematic Conservation Planning *(SCP) is an approach to protected areas planning that follows a defined step-by-step process [1]. It ensures that social, economic, and ecological dimensions are integrated. Adopted from Nelson et al. (2023)*

A ***recovery plan*** *serves as a roadmap for species recovery, detailing the management actions required to achieve successful restoration. It plays a vital role in identifying, organizing, coordinating, and prioritizing recovery efforts, ensuring that decisions are guided by sound science and strategic planning. These plans should establish clear objectives and integrate knowledge from diverse disciplines, including ecology, taxonomy, genetics, and social sciences. Adopted from Nelson et al. (2023)*

Ecosystem restoration *is the process of stopping and reversing degradation to enhance ecosystem services and restore biodiversity. It spans a broad range of practices tailored to local conditions and shaped by societal preferences. Adopted from Nelson et al. (2023)*

Species recovery *is the process of halting or reversing the decline of a threatened or endangered species, ensuring its long-term survival in the wild. The goal is to restore the species to a state where it no longer requires legal protection. Adopted from NOOA (2020)*

7. There is another term that will be covered in these guidelines, and which needs to be defined. The guidelines not only cover recovery planning but also planning for marine emergencies and acting upon the occasion of such. Therefore, we need to define what accounts for an emergence in relation to marine species.

Ecological emergency *is herein after defined as an urgent threat to marine species that can lead to imminent death or mass mortality and therefore requires an immediate response to avoid disastrous outcomes. (Author's own elaboration)*

Further to these fundamental defintions, each section will have additional definitions, as relevant to the specific sections

1.2. Marine species recovery

8. Marine species recovery, compared to terrestrial species, comes with additional challenges due to the dynamic, open system of the marine environment and related uncertainties. Ecosystem responses are diverse and depend on ecological redundancy, connectivity, and the nature of disturbances. Species recovery may be achieved through either or both passive or active interventions and can lead to full or partial recovery outcomes, depending on the baseline, the interventions themselves, and the level of damage from human activities or natural disturbances [4]. However, the rate at which species (and habitats) recover differs from

species to species depending on their biology, threats, and other circumstances [5,6]. Longer recovery times are generally observed for deep-sea species [6], long-lived species, species with small and fragmented populations, and species with particularly intractable threats [5]. In some cases, a recovery may not even be possible anymore. Long-lived marine species, such as whales and sharks, take decades to recover, while others like sardines show quicker recovery [6,7]. In terms of species recovery and ecosystem stability, there are three key terms to be distinguished and factors to be considered [4]:

- Recovery, whereas balancing disturbance and recovery rates is critical for maintaining structure.
- Resistance, which is influenced by ecological redundancy and the role of key species.
- Reversibility, considering that ecosystem shifts may be irreversible, often due to new ecological players like marine diseases.

9. It is noteworthy that specific factors can alter or impact nature recovery:
    - The recovery potential varies by location and in relation to the connectivity between ecosystems.
    - Long-term shifts may be undetected at first.
    - Indirect effects such as the introduction of new species can delay recovery progress [4].

10. It is important to prioritise keystone species for restoration approaches and enhance habitat diversity. Remediation and mitigation are more effective than restoration and should therefore focus on high-quality habitats [8]. Reducing human impacts, especially exploitation, protecting critical habitats (e.g. VMEs), and controlling pollution are critical for recovery [8,9] . There are also examples where assisted reintroductions have helped species population to recover [10]. However, climate change alters environmental conditions and can make some restoration targets unrealistic, requiring a more proactive and flexible approach [11,12].

11. Species recovery will require a combination of strategies (protecting habitats, reducing pollution, mitigating climate change) to be effective. Some estimates state recovery times of 21 years for 90% of marine populations [13]. However, as explained above and further illustrated in the following, this might not be true for all species and habitats.

1.3. Marine emergencies

12. Marine emergencies may include pollution events such as oil spills, strandings, algal blooms, or disease outbreaks, affecting both marine species, including aquaculture and natural populations, and habitats [14–17]. Considering the extent of these emergencies there are different levels of responses and coordination from local to national to regional or even international-scale interventions. With these different levels, emergency frameworks can be applied to help prepare or prevent such emergencies. Such frameworks include, for example, risk assessments, response networks, contingency plans, or cross-company collaborations with specialized training providers [14,15,18]. Although diseases occur naturally in marine systems, they can pose a risk if caused, accelerated or spread through human activities. There are multiple factors that influence disease occurrence, spread and outcomes, including pathogen dynamics, host susceptibility, and environmental factors such as heat waves, currents, etc. [15]. Limitations relating to the detection of marine pathogens and their diagnostics, as well as in relation to active surveillance, which often comes with high costs, enhance the challenge to manage and prevent marine disease outbreaks [15].

2. Policy and legal context Mediterranean region

13. Ecosystem and species recovery have gained more attention and commitment in the past decades due to drastic declines and state shifts in the natural environment. There are now several legally binding and voluntary commitments for nature restoration that countries have committed themselves to. These are summarised in the following sections.

2.1. Global commitments to recovery

14. Ecosystem restoration is governed by a range of international legal frameworks, treaties, and policies aimed at halting biodiversity loss, mitigating climate change, and promoting sustainable development. Key instruments include:

- **The Convention on Biological Diversity (CBD)**: Under the CBD, Parties are also required to adopt national biodiversity strategies and action plans (NBSAPs) that integrate species recovery efforts. The CBD emphasizes ecosystem restoration as a crucial strategy for achieving the *Aichi Biodiversity Targets* (particularly Target 15) and the *Kunming-Montreal Global Biodiversity Framework (GBF)*, which calls for restoring at least 30% of degraded ecosystems globally by 2030 (Target 2). Target 2 of the GBF relates to the framework's other target, including Target 4 for threatened species, as shown in Figure 1.

Aichi Target 15
By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

Target 2 GBF
Ensure that by 2030 at least 30 per cent of areas of degraded terrestrial, inland water, and coastal and marine ecosystems are under effective restoration, in order to enhance biodiversity and ecosystem functions and services, ecological integrity and connectivity.

Target 4 GBF
Ensure urgent management actions to halt human induced extinction of known threatened species and for the recovery and conservation of species, in particular threatened species, to significantly reduce extinction risk, as well as to maintain and restore the genetic diversity within and between populations of native, wild and domesticated species to maintain their adaptive potential, including through in situ and ex situ conservation and sustainable management practices, and effectively manage human-wildlife interactions to minimize human-wildlife conflict for coexistence.

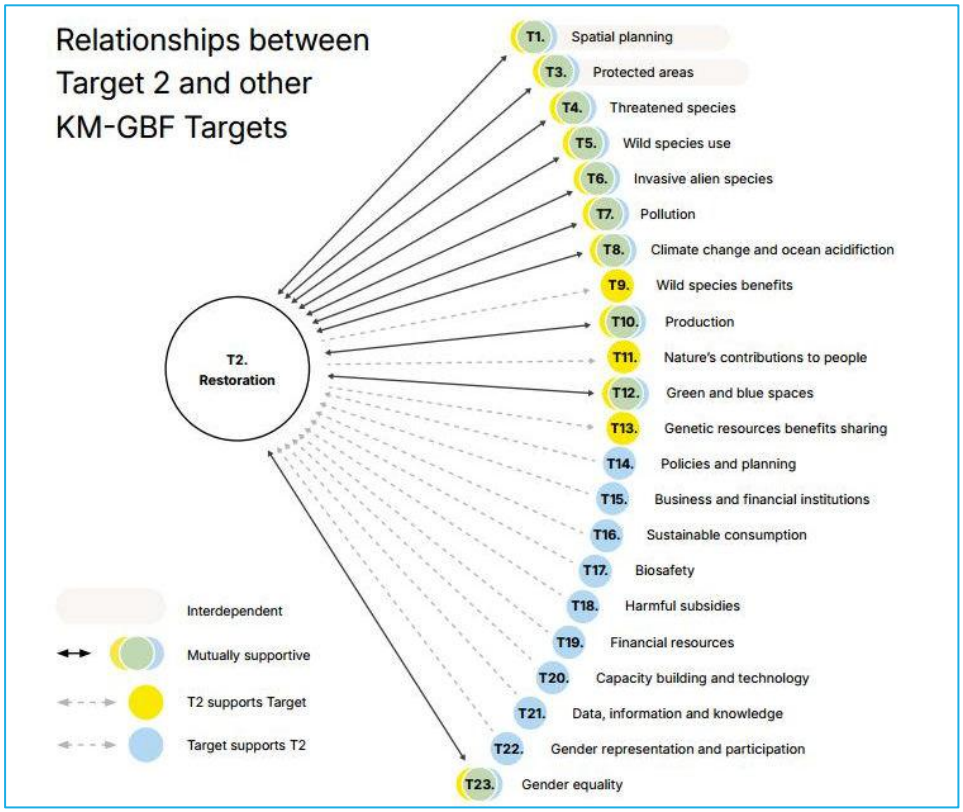

Figure 1. Relational schematic between the targets of the Kunming-Montreal Global Biodiversity Framework created by © FAO, SCBD and SER, 2024

- **United Nations Framework Convention on Climate Change (UNFCCC)**: Restoration is linked to climate mitigation and adaptation goals, including through initiatives such as the Paris Agreement and Nationally Determined Contributions (NDCs), which encourage incorporating restoration into climate action plans.
- **Ramsar Convention on Wetlands**: This treaty supports the restoration of degraded wetlands to sustain biodiversity and maintain vital ecosystem services. It obligates countries to protect and restore wetlands critical for migratory birds, fish, amphibians, and other species.
- **Sustainable Development Goals (SDGs)**: Several SDGs underscore the importance of restoration, particularly SDG 13 (Climate Action), SDG 14 (Life Below Water), and SDG 15 (Life on Land).
- **UN Decade on Ecosystem Restoration (2021-2030)**: Proclaimed by the UN General Assembly, this initiative mobilizes global efforts to prevent, halt, and reverse ecosystem degradation, serving as a framework for achieving restoration commitments under multiple international agreements.
- **Convention on the Conservation of Migratory Species of Wild Animals (CMS)**: The CMS obligates countries to protect migratory species and restore critical habitats along migration routes, including marine corridors.
- **European Union Policies**: While region-specific, the EU Biodiversity Strategy for 2030 and the *Nature Restoration Law* align with global restoration goals by setting binding targets to restore degraded ecosystems across member states.

15. The above listed obligations are supported by funding mechanisms such as the Global Environment Facility (GEF) and Green Climate Fund (GCF), along with voluntary commitments under programs like the Bonn Challenge and initiatives led by the International Union for Conservation of Nature (IUCN).

16. In essence, international policies and legal frameworks aim to integrate ecosystem restoration into broader goals of sustainability, biodiversity conservation, and climate resilience, fostering collaboration across nations to achieve ambitious restoration targets.

2.2. Mediterranean species, targets and key actors

17. Ecosystem restoration and species recovery in the Mediterranean are supported by a range of international legal frameworks (as listed in the previous section), regional agreements, and collaborative initiatives that address the unique ecological challenges of the region. These obligations focus on halting biodiversity loss, restoring degraded habitats, and protecting threatened species:

Barcelona Convention and its Protocols

The Barcelona Convention for the Protection of the Mediterranean Sea and its Protocol on Specially Protected Areas and Biological Diversity (SPA/BD) focus on ecosystem restoration and species recovery. Countries must identify and protect endangered species and their habitats, with obligations to restore habitats essential for threatened species. Several regional action plans have been developed to guide these commitments:

- Regional strategy for the conservation of Monk Seal in the Mediterranean
- Action Plan for the conservation of marine turtles
- Action Plan for the conservation of cetaceans
- Action Plan for the conservation of marine vegetation
- Action Plan for the conservation of bird species listed in annex II of the SPA/BD Protocol
- Action Plan for the conservation of cartilaginous fishes (Chondrichthyans) in the Mediterranean Sea
- Action Plan concerning species introduction and invasive species
- Action Plan for the conservation of the coralligenous and other calcareous bio-concretions in the Mediterranean Sea
- Action Plan for the conservation of habitats and species associated with seamounts, underwater caves and canyons, aphotic hard beds and chemo-synthetic phenomena in the Mediterranean Sea (Dark habitats Action Plan)

The Strategic Action Programme for the Conservation of Biological Diversity in the Mediterranean Region (SAPBIO) outlines a long-term vision for the Mediterranean region and was aligned with the CBD Post-2020 Global Biodiversity Framework and SDGs in 2019, following a request by the Barcelona Convention COP 21.

Responsible for the implementation and administration of these obligations is the UNEP/MAP-Barcelona Convention system and respective entities.

European Union Policies (for EU Mediterranean countries) under the remit of the EU Commission include:

- **EU Birds and Habitats Directives**: Legally binding obligations require the protection and restoration of habitats for species listed in Annexes I and II, as well as the recovery of populations of threatened birds and other wildlife.
- **EU Biodiversity Strategy for 2030**: Includes commitments to restore habitats critical for species recovery, with specific measures to improve the conservation status of at least 30% of species and habitats protected under EU law.
- **Marine Strategy Framework Directive (MSFD)**: Requires EU countries to restore marine habitats and achieve *Good Environmental Status (GES)*, including recovery of overexploited marine species.
- **EU Nature Restoration Law** aligns with global restoration goals by setting binding targets to restore degraded ecosystems across member states.

Regional fisheries management organisations (RFMOs), including **the International Commission for the Conservation of Atlantic Tunas (ICCAT)** and the **General Fisheries Commission for the**

Mediterranean (GFCM), are responsible for managing commercial fish species and those species affected by regional fisheries, which includes the recovery of depleted stocks.

Non-governmental organisations (NGOs) are key players to support conservation efforts in the region and actively involved in the implementation of regional action plans as partner organisations. Examples include the IUCN Med office and WWF Mediterranean Programme, among others.

Other associations and consortiums have formed to foster, monitor and support a sustainable marine future for the Mediterranean Sea, including MedPAN and the Med Sea Alliance. **The Union for the Mediterranean (UfM)** promotes regional cooperation for ecosystem restoration and species recovery, including commitments under the 2030 GreenerMed Agenda to restore habitats and safeguard biodiversity, focusing on endemic and endangered Mediterranean species.

2.3. Challenges and threats to biodiversity in the region

18. Challenges and causes of decline of marine life have long been recognised and incorporated into international law to be addressed (Figure 2) [13]. The Mediterranean Sea has not remained unaffected by these global changes. In fact, both the EU's Ocean State report and the IMAP Quality Status Report (Decision IG.26/3) highlight that the effects of climate change and species declines are exacerbated in the region, with ecosystem shifting rapidly to more acidic and hotter marine waters that foster the occurrence and spread of diseases.

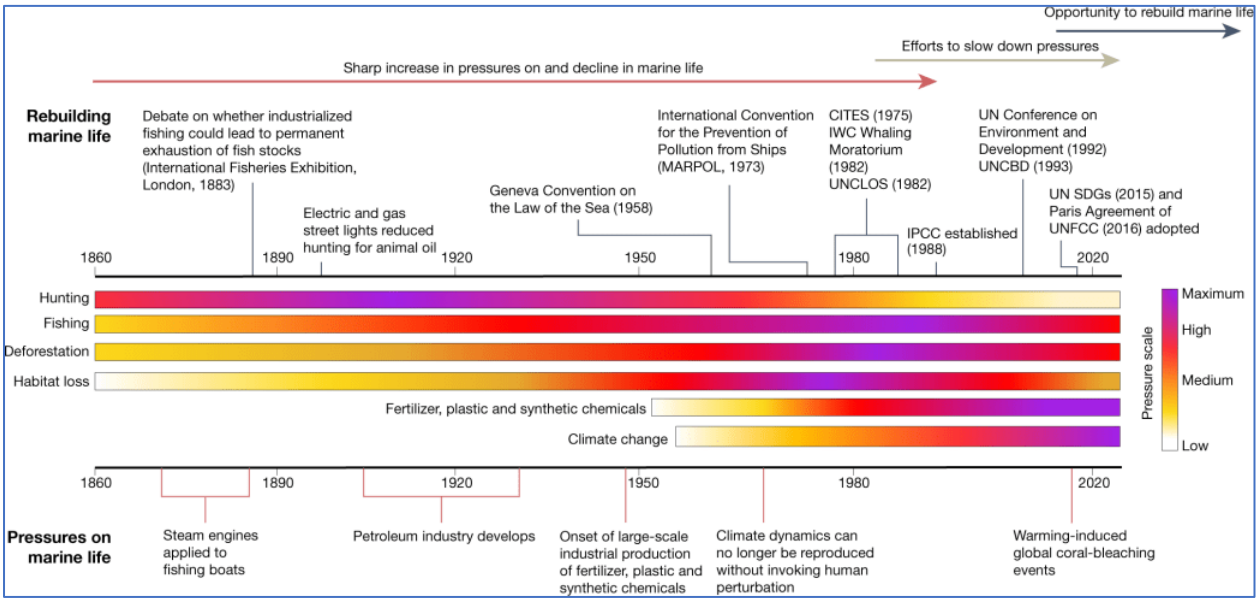

Figure 2. Global pressures on marine life and related legal developments. Source: Duarte et al. (2020)

19. The post-2020 SAPBIO also noted that progress towards good environmental status (GES) has been too slow, and there are multiple drivers of change to be address. Mediterranean marine ecosystems and species are affected by intense fisheries and maritime traffic, marine litter, land-based pollution, the introduction and spread of alien invasive species, underwater noise, and combined impacts from different sources of physical and chemical pollution[19]. Underlying knowledge gaps and insufficient data sharing efforts enhance these problems and hinder efforts to combat these challenges. A study that quantified and mapped cumulative impact of 22 drivers to 17 marine ecosystems revealed that 20% of the entire Mediterranean basin are heavily impacted, with high human impact occurring across subregions and territorial seas (Figure 3) [19].

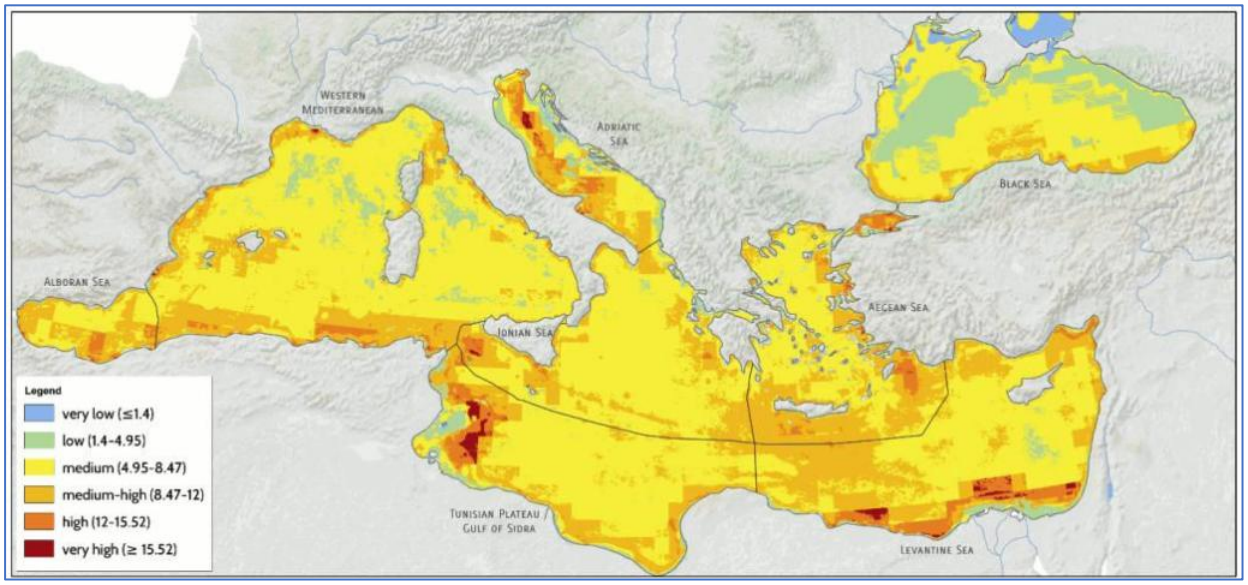

Figure 3. Spatial distribution of cumulative impacts to marine ecosystems of the Mediterranean and Black Sea based on the work of Micheli et al. (2013). Colours correspond to the different impact categories (see legend).

20. In summary, the Mediterranean faces urgent challenges, including habitat loss, overexploitation of species, climate change impacts, and pollution. Collaborative action, robust policy implementation, and adequate funding are essential to meet species recovery obligations and achieve sustainable ecosystem restoration.

3. Pre-planning considerations, decisions and actions

3.1. Plan options

21. The first step, which defines the biological scope and scale of any species recovery plan, is to decide on the species. This may seem clear or may be guided by legal obligations, but it entails more than simply choosing one species. It requires both prioritisation of multiple threatened species in need of action, and an assessment whether recovery is possible, and where efforts are best placed. There are multiple approaches to do so or combine efforts for multiple species. Species recovery plans can be designed for a single species, multiple species, or at an ecosystem level, depending on what is most feasible, practical, and achievable [20].

22. Single species recovery plans have long been the norm, but multi-species plans also have value and are being considered, as the examples presented in Annex, Table 3 demonstrate. While multi-species plans may have the advantage of combining resources and thereby effectively broadened conservation efforts [20], they also faced some criticism in that they often present a poor understanding of species-specific biological and ecological needs, and connectivity between species and habitats, and are less likely to include adaptive management [21]. However, research has shown that multi-species approaches could be improved considering similarities in threats to identify appropriate groupings for such a plan and thereby maximizing benefits while minimizing drawbacks [21]. Effective groupings for a multi-species approach are typically composed of species that:

Box 1: For more information on combined threat-similarity assessments:

Source: Lees et al. (2021). Science-based, stakeholder-inclusive and participatory conservation planning helps reverse the decline of threatened species. *Biological Conservation*, *260*, 109194. https://doi.org/10.1016/j.biocon.2021.109194

Source: Clark & Harvey (2002). Assessing multi-species recovery plans under the Endangered Species Act. *Ecological Applications*, *12*(3), 655-662. https://doi.org/10.1890/1051-0761(2002)012[0655:AMSRPU]2.0.CO;2

1. Face similar threats within a specific geographic or political region;
2. Depend on the same threatened ecosystem, habitat, or microhabitat;
3. Are similarly impacted by common threats;
4. Require intensive management either in situ or ex situ; or
5. Have needs that align closely with those of a high-profile "umbrella species"[5].

23. A distinction is also made between species that occur on small, localized areas and those that migrate through international waters and multiple jurisdictions [20]. If migratory species are considered in the plan, then the planning would most likely require cooperation with other countries and the consideration of a wider legal and policy framework (see sections 2.1,2.2, and 11). This could also entail the development of multiple, coordinated recovery plans across regions or countries. Additionally, a recovery plan for a wide-ranging or migratory species could have chapters for different recovery units or subpopulations.

24. Although the focus of a species recovery plan is or are selected species; there is a need to consider the ecosystem functions they deliver and depend on. Therefore, the planning process should consider restoring such functions and addressing threats at an ecosystem-level, if and where possible. Maintaining and securing habitats is essential, especially for those species that present small, localised populations and high habitat-dependencies.

Circumstances where the different options are most appropriate:

Single species plan: the species is distinct from other species in terms of distribution, habitat requirements and pressures/threats that require a conservation or management intervention. Such interventions are considered effective and feasible for this species in a specific area or at a national or local level.

Multiple-species plan: if two or more species share a geographic area, are threatened by the same or similar pressures and would benefit through a combined approach for conservation or management.

Ecosystem plan: if a range of species would benefit from restoring specific ecosystem functions over a defined geographic space, then this type of plan might be best suited. This would require an understanding of different species' needs and biological connections within the ecosystem and to other species. The criteria for measuring successful recovery would also need to be defined at an ecosystem level (see more in section 5.3).

Some authors highlight the need to shift from a single species to a more systematic, ecosystem-level approach to recognise and address the complexity of the ecological interaction across systems [22]. Such approaches also need to be adaptive to cope with future climate-change conditions [23].

Whether an individual recovery plan is needed will also depend on existing plans and measures. In some cases, a recovery plan can supplement other measures or plans, or maybe be combined with such. Some key questions for determining which options are most suitable are summarised in Box 2.

Box 2: Key questions for selection options

- What are the species in need of a recovery plan?
- Where does the species occur? (incl. transboundary occurrence)
- Does the distribution overlap with other species?
- What are the threats that affect this species? (see more in section 4.2.1)
- Are there other threatened species in the same area that face similar pressures or threats?
- What role has/ have this/these species in the ecosystem?
- Are there existing measures or plans in place?

3.2. Scale & scope

25. The selection of species will determine the biological scale and scope and guide every step of the planning process. However, there are some consideration worth highlighting in relation to the scale. There are two main factors that can determine the scope and scale of actions required- the species distributional range and the scale of threats that need to be addressed. In some cases, the spatial context in which the plan operates is more important the species selected [22]. One way to prioritise efforts at national level is to focus on mapping critical habitats and prioritizing habitats over individual species[24]. Another approach would be to consider the creation of 'Nature recovery networks', which aim to create interconnected habitats for wildlife recovery, focusing on evidence-based, locally developed, and nationally aligned spatial planning [25]. There are tools and approaches available that can help to determine and prioritise areas (see Box 3 for more information).

Box 3: Tools for prioritisation

Source: Mosedale (2023). Identifying and prioritising marine nature recovery (MNR) opportunities. https://www.cornwallwildlifetrust.org.uk

Source: Saunders et al. (2022). A roadmap for coordinated landscape-scale coastal and marine ecosystem restoration. Cairns, Australia. https://www.nespmarinecoastal.edu.au/wp-content/uploads/2023/09/NESP-MaC-Hub-Project-1.1_Saunders-et-al-FINAL-REPORT.pdf

26. Another important, but often disregarded aspect, is the connectivity between marine, freshwater and terrestrial systems both in terms of functioning and threats. There are different metrics that determine and measure this connectivity [26]. These metrics can reflect structural functions such as energy or gene flows, or spatial functions, including species distributions and populations sizes [26]. Measuring connectivity can evaluate co-benefits of nature recovery, including species richness, target species abundance, and functional richness [27]. A prioritization framework is useful for agencies and managers looking to implement actions guided by multiple objectives to ensure actions are efficient and effective across the land and sea [28].

27. Considering migratory species in the recovery plan will also influence the scope and scale, as this would require an understanding of threats across the species' distributional range and which actors can contribute to the recovery of the species. Migratory species are likely to require a regionally coordinated recovery plan or plans.

28. The scale and scope of the plan will also determine which stakeholders will need to be engaged in the process. It is advised to map these prior to drafting the plan (see more in section 6.1).

3.3. Site selection

29. Independent of the recovery approach and measures taken (see section 5.5), it is important to decide where efforts are best placed. Mapping potential priority habitats and areas with recovery potential can be a powerful tool. For maps to be useful, they need to fulfil some basic criteria [25]:

- Be based on the best available information and reviewed as more data becomes available;
- Consider connectivity between habitats and species distributions;
- Evaluate and provide options for recovery networks;
- Reflect natural processes;
- Are easy to read and interpret and accessible to all stakeholders.

30. Utilising sites that are already identified as important and potentially have received protection through a marine protected area (MPA) designation can be a good approach for species. However, to understand the usefulness and suitable for selected species, especially those that move around, acoustic telemetry and species movement models can optimize spatial coverage and management [29,30].

31. Strategic site selection and spatial planning for marine ecosystem restoration, especially when applied at broader spatial scales and considering ecosystem service outcomes, can enhance the effectiveness of restoration efforts [31]. Box 4 summarises some key questions that need to be answered when determining where to place recovery or restoration actions.

Box 4: Key questions for selection options

- Which sites are crucial to support species recovery?
- Are there any claims/tenure or other rights to this site?
- Is this site suitable for recovery?
- Are there any current measures or frameworks in place under which the site is covered?

3.4. Baselines, reference sites, and reference models

32. Before the recovery plan is drafted, it is important to understand the site conditions and conduct a comprehensive assessment. This assessment should not only include the ecological status of the site, but also economic, social and cultural aspects.

33. A baseline is an account of existing conditions in a particular space and point in time based upon which change in that same space can be measured. A challenge that both scientists and decision-makers face in relation to these reference conditions is an undetected shift over time due to global drivers of change [32].

Shifting baseline syndrome (SBS) *refers to the gradual lowering of what is considered "normal" environmental conditions with each successive generation. This leads to an underestimation of the full extent of long-term environmental change on a global scale. It is important to account for SBS when utilizing local ecological knowledge and participatory methods in setting conservation targets. From Jones et al. (2020)*

34. Ecological factors that should be incorporated into the baseline assessment of the site include the key functions and the ability to restore these to a comparable reference site or reference conditions, either fully or partially [33,34]. Without baseline information on species and/or habitats, including an understanding of underlying threats and causes of degradation, it will not be possible to define success criteria, set sensible targets, and measure recovery progress [22,35] .

Reference site *is an area that closely resembles the environmental conditions of the site to be restored but has experienced minimal to no human-caused degradation. When available, multiple reference sites can be utilized to accurately represent the average condition (and the range of variability) that the restoration site would have exhibited if degradation had not taken place. Adopted from Nelson et al. (2023)*

35. Modelling approaches can help to determine a baseline or reference conditions for restoration [3,36]. Global best practice guidance highlights that such reference models are most reliable when informed by multiple sources of data, including reference sites—locations with environmental conditions similar or comparable to the project site, ideally exhibiting minimal degradation [3]. Identifying one or more reference models can benefit various aspects of a restoration project. As noted earlier, these models can help assess the extent of degradation in the project's abiotic conditions, species composition, and ecosystem structure and function [3]. More detailed insights on some of these aspects can be found in Box 5.

Box 5: For more information on baselines, reference sites and points for stock recovery, and modelling reference conditions, see:

Source: 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

Source: Zimmermann & Werner (2019). Improved management is the main driver behind recovery of Northeast Atlantic fish stocks. Frontiers in Ecology and the Environment, 17(2), 93-99. https://doi.org/10.1002/fee.2002

36. Due to the uncertainties in baseline determination and limited availability of historical data, some researchers support the use of dynamic baselines to assess conservation impacts [37].

37. Recognising the challenges of baselines and reference conditions is leading to new the consideration of new narratives in which restoration would not only or at all aim at delivering historic conditions but may lead to the creation of novel ecosystems [34].

38. Looking ahead, marine systems will drastically change, and restoration measures will need to be evaluated against a moving baseline, impacted by climate change [1]. Further than using baselines for determining restoration success (or failure), baselines are also essential for detecting thresholds (see section 4.2.1) and disease outbreaks to allow for timely responses and avoid emergencies [18]. Box 6 outlines some key questions in relation to baselines.

Box 6: Key questions for baselines

- What data is needed to determine a baseline?
- Do we have this data available and, if not, what needs to be done to gather it?
- What type of baseline or reference is most appropriate?
- Can the species population be restored to that level?

3.5. Recovery plan development, lead and contributors

39. Recovery planning necessitates a process that incorporates both internal and external engagement (more in section 6). It is important to establish clear expectations, address issues, define responsibilities, and outline lines of communication between different organisations and stakeholders involved in the recovery process. A timeline should be created to guide the completion of key milestones, including setting the frequency of public meetings and plan reviews, as well as establishing time limits for each step.

40. Prior to initiating the drafting of a species recovery plan, it should be clear who is responsible for this complex task. The task may fall to a government employee, a marine biologist, or a contractor. Important in either case is that the development of the plan is an integrative and transparent process (see general principles and stakeholder engagement sections 4.1 and 6.1). In some instances, especially for multiple species or ecosystem-level plans, a good approach is to establish a ‘recovery team’ that will oversee the drafting stage. There are distinct advantages to establishing a recovery team [20]. These advantages include a variety of perspectives that can identify obstacles and issues early on and provide a forum for conversation and interaction to resolve them. A core team composed of different entities and actors can also support the timely and effective implementation of restoration measures and, in the process, develop advocates for the recovery programme. On the other hand, there are also disadvantages to be considered. The larger the team is, the more opinions they bring to the table, and this can lead to inconclusive meetings that can prolong the decision-making process. It also more difficult to establish consent and balance views without undermining minorities. More people require also more coordination and resources in the planning process.

41. These are all aspects to be considered in the pre-planning phase. Whether or not you need a recovery team, there should be cross-organisational collaboration and stakeholder involvement throughout the drafting process. Box 7 provides a summary of pre-plan development considerations.

Box 7: Pre-planning checklist (based on NOOA, 2020)

- Have you decided on the scope of the recovery plan? (single species, multiple species, ecosystem; geographical scope, …)
- Is there any existing or alternative plan for the species that needs to be considered?
- Is/are the selected species requiring special considerations in terms of cross-border collaboration, cultural significance, etc.?
- Have you decided on the timeline and structure of your recovery plan? (See more in the next section)
- Have you determined who will lead and be responsible for the drafting of the plan and who needs to be involved?
- Have you determined a baseline? Or identified reference sites/conditions?
- Have you identified/map all relevant stakeholders? *(more in section 6)*
- Have you planned your stakeholder engagement? *(more in section 6*)
- Have you set up a file for the plan?

4. Structure and fundamental elements of a recovery plan

42. Writing a recovery plan is not a linear process and before a plan is drafted it is likely one will go back and forwards between sections. A useful approach to drafting a plan is to first write a recovery outline that structures the key consideration that need to go in the plan and stipulates and overall vision for the species' recovery. A recovery outline is a strategic document consisting of the following key components:

- Species name
- Range
- Status (e.g. IUCN Redlist, national population, subpopulation, etc.)
- Leading agency for the recovery plan
- Background (scientific evidence summary)
- Interim recovery program (if available)/ current management/conservation efforts

43. A recovery plan itself must incorporate, at a minimum:

- A description of site-specific management actions necessary to achieve species recovery.
- Objective, measurable criteria which, when met, would result in a determination that the species is no longer threatened.
- Estimates of the time and costs required to achieve the plan's goal [20].

44. Looking in more detail across the guidance available (Annex, Table 4), a species recovery plan should further have the following [3]:

- A comprehensive risk assessment addressing ecological, cultural, and legal concerns;
- Explicit plans, maps, schedules and budgets for restoration activities, including plans for contingencies;
- Plans and procedures for implementation and ongoing management activities (including their description, duration and frequency);
- A monitoring and evaluation plan, including procedures, schedules and budgets; and
- A detailed data and information management plan.

45. Considering the complexity of nature recovery, recovery plans do not need to be presented in form of a single document but may be split between different components [20], to account for different steps or phases in the process (Figure 4). Drafting a background document with all the pre-assessment information, including threats and species status avoids a lengthy introduction.

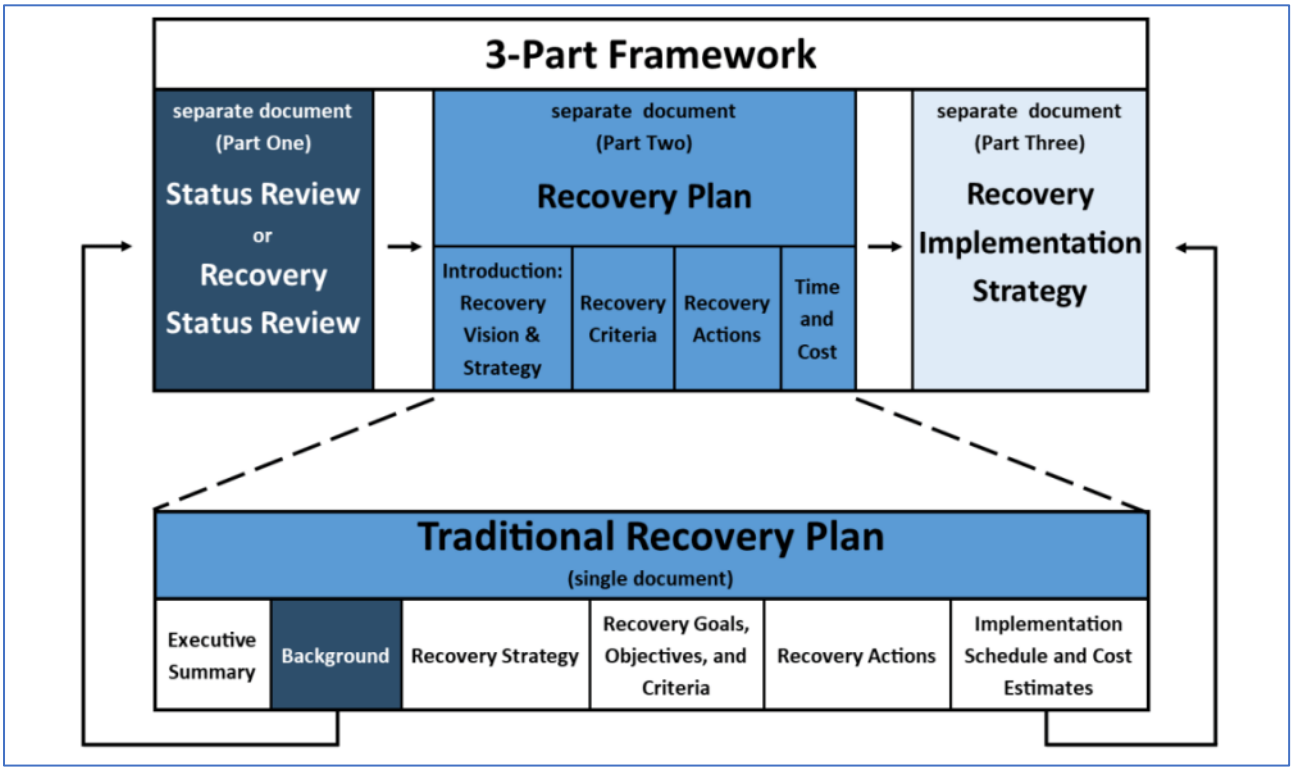

Figure 4. Comparison between traditional recovery plans and al 3-part framework for recovery plans

46. Rather than a traditional approach to cover every aspect of recovery actions, their implementation, and management in one document, a separate implementation strategy might be a better approach. Such a strategy can clarify, in more details, each step of the process, the actors involved and responsible, the funding, etc. without creating one very lengthy recovery plan. The recovery implementation strategy should be a flexible document that lays down a step-by-step approach to activities required to fulfil recovery actions.

4.1. General principles and best practices

47. Before going into each part of a recovery plan, it is important to reflect on some overarching principles that should guide the entire drafting and implementation stage. First, there are some key terms requiring a definition. These definitions are adapted from Metzger et al. (2017):

Adaptive management *is an approach based on iteration and continuous learning, where actions are regularly tested and assessed to enable ongoing improvement. This method addresses uncertainty and gaps in knowledge during decision-making, bridging the divide between science and practice.*

Participatory approach *is a method that actively involves a diverse group of stakeholders throughout the entire process, from designing to evaluating scenarios. This approach incorporates various perspectives and concerns, enhancing the analysis of synergies and trade-offs.*

Transdisciplinary *is an approach or methods that extends beyond academic boundaries, combining knowledge from both academic sources and non-academic contributors (such as practitioners' empirical experience or local knowledge) to address a shared research objective.*

48. Effective planning builds the fundament for successful species and habitat recovery and underpins the entire restoration process. Experts have developed key principles to nature recovery and restoration[38–40]. One good example is the 'standards of practice to guide ecosystem restoration' published by the FAO, IUCN CEM and SER in 2021 [2,3],1 which include:

1. **Global contribution**: ecosystem restoration contributes to the United Nations (UN) sustainable development goals and the goals of the Rio conventions.
2. **Broad engagement:** ecosystem restoration promotes inclusive and participatory governance, social fairness and equity from the start and throughout the process and outcomes.
3. **Many types of activities**: ecosystem restoration includes a continuum of restorative activities
4. **Benefits to people and nature:** ecosystem restoration aims to achieve the highest level of recovery for biodiversity, ecosystem health and integrity, and human well-being.
5. **Addresses causes of degradation:** ecosystem restoration addresses the direct and indirect causes of ecosystem degradation.
6. **Knowledge integration:** ecosystem restoration incorporates all types of knowledge and promotes their exchange and integration throughout the process.
7. **Measurable goals:** ecosystem restoration is based on well-defined short, medium and long-term ecological, cultural and socio-economic objectives and goals.
8. **Local and land seascape contexts:** ecosystem restoration is tailored to the local ecological, cultural and socio-economic contexts, while considering the larger landscape or seascape.
9. **Monitoring and management:** ecosystem restoration includes monitoring, evaluation and adaptive management throughout and beyond the lifetime of the project or programme.
10. **Policy integration:** ecosystem restoration is enabled by policies and measures that promote its long-term progress, fostering replication and scaling-up

These principles should inform and be widely applied across the process (Figure 5) [2].

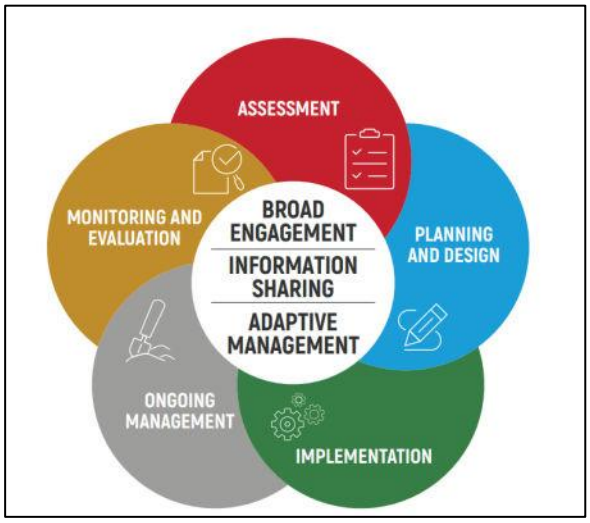

Figure 5. Stages of recovery planning and guiding principles (centre). Source: Nelson et al. (2024)

49. The standards of practice also make a point about an integrative approach to both planning and implementation of recovery actions by applying one or more of the following concepts: co-creation, co-development, co-management, and co-governance [2]. Furthermore, it is important for governance structures to be transparent and inclusive, blending formal systems with wider community participation and building partnerships that ensure effective implementation (more in section 6.2). Another key aspect for the delivery of species recovery actions and one that is further explained in section 10, is securing funding for all stages of the recovery process. Some thinking that should be applied across the planning process is:

[1] FAO: Food and Agriculture Organisation of the United Nations; IUCN CEM: International Union for the Conservation of Nature - Commission on Ecosystem Management (CEM); SER- Society for Ecological Restoration

- Apply ‘bigger, better, more and joined-up’ approach;
- Avoid adverse impacts;
- Apply ‘right place, right time’ approach;
- Plan for the future;
- Engage with other disciplines (transdisciplinary approach);
- Apply existing knowledge and share lessons learnt [41].

4.2. Species overview and status review

50. Whether in a separate document or as part of an overarching recovery plan, a comprehensive review and assessment of the species status, including its biology, ecology, and threats is a fundamental step in the process. This should be based on the best available scientific evidence but also consider the knowledge of local communities and relevant stakeholders, such as fishers. This status review will not only inform success criteria for species’ recovery (see section 5.3), but also explain the pressures and threats that need to be addressed in the actions and subsequent implementation stage. In a multi-species or ecosystem-level plan, this section can be quite lengthy and extensive and therefore a separate document might be the preferred option. A summary of such a document could then be linked to the actual recovery plan and implementation strategy, if these are separated too. Each of the species and if so, relevant habitat, should be addressed in the status review. The reader or respective stakeholder should be able to easily understand the information presented in the status review and how pressures/threats overlap for multiple species, in case of a multiple species plan. Elements of the species status and background are summarised in Box 8, and more considerations on threat-similarities are described in the following section.

Box 8: Elements of the species background and status review

- Legal status
- Species description and taxonomy
- Populations, trends, and distribution
- Life history
- Habitat characteristics and critical habitats
- Ecosystem role
- Threat assessment *(see next section)*
- Current and planned conservation and management efforts
- Biological needs and constraints (limiting factors that might impact the recovery process)

Threat analysis/assessment (incl. climate change considerations)

Box 9: Detailed methods for determining thresholds and conduct a cumulative effects assessment:

Source: Foley et al (2015). Using ecological thresholds to inform resource management: current options and future possibilities. Frontiers in Marine Science, 2, 95. https://doi.org/10.3389/fmars.2015.00095

Source: JPI Oceans (2024). A common handbook: Cumulative effects assessment in the marine environment. JPI Oceans Knowledge Hub on Cumulative effects of human activities in the marine environment. https://dx.doi.org/10.48470/77

51. Understanding the threats that have or will lead to the decline of species in the fundament for determining actions required to address them. However, it is not as simple as knowing that overfishing affects many fish species, or that pollution has negative impacts on benthic species and habitats. A systematic threat analyses goes beyond generalising human-induced pressures and should consider the drivers of change, cumulative impacts, and multiple effect levels (e.g., physiological effects, effects on the reproduction, behavioural effects, habitat degradation, etc.) over multiple timescales [9,19,42–44]. Box 9 provides more information on these aspects.

__A driver__ is a defined as any natural or human-induced process, event, or activity that exerts pressure on an ecosystem, leading to changes in its processes, components, functions, properties, or services. Anthropogenic drivers can either be direct or indirect. Direct drivers are human-driven processes that have an immediate impact on ecosystems, stemming from deliberate human decisions. These drivers can contribute to degradation (e.g., habitat destruction, invasive species introduction, infrastructure development) or support restoration efforts (e.g., reforestation, dam removal). Indirect drivers are human-controlled factors that influence the level or rate of change of one or more direct drivers. They typically serve as underlying causes of changes in biodiversity and nature's benefits, encompassing institutional and governance structures, along with socio-political, economic, technological, legal, and cultural factors. These drivers can impact both degradation processes and restoration efforts. Adopted from Foley et al. (2015) and Metzger et al. (2017)

An __ecological threshold__ is a point or zone of rapid, non-linear transformation in any state variable or parameter of an ecosystem (such as habitat loss, nutrient cycling, or population viability thresholds) driven by one or multiple environmental pressure(s). This non-linear behaviour means that minor changes in an environmental driver can lead to significant ecological shifts. Adopted from Foley et al. (2015)

__A cumulative effect assessment__ is comprehensive evaluation of combined impacts of human activities and natural processes on the environment. It can be considered a specialized form of environmental impact assessment (EIA). Adapted from JPI Oceans (2024)

52. A threat analysis should therefore consider any causes of decline in the past, the present and anticipated future and their sources. The analysis of each threat and its respective source should cover the geographical

extent – both scope and severity-, and frequency. This includes those threats that can be managed at national scale, those requiring international cooperation, and even those for which currently no intervention options are available. The analysis should also consider the threats' relevance for the species recovery. To prioritise actions, identified threats should be ranked based on whether they are manageable and an obstacle to recovery. Box 10 points out some key questions the treat analysis should answer.

53.

Box 10: Key questions for the threat analysis

- What are the pressures/threats the species or its habitat are facing?
- What causes these pressures/threats?
- Can they be managed/changed?
- Are there threats in the past that could re-appear?
- What are future, anticipated threats?
- What are methods or actions to tackle these?
- What other species are affected by these threats?
- How would actions affect these species?
- Who is affected or responsible for these pressures/threats?
- Who could influence or help to reduce/mitigate/eliminate threats/pressures?

5. Developing a recovery implementation strategy

54. Whether integrated into a wider recovery plan or as a separate strategic document, the design and implementation of recovery interventions should follow a structured approach, guided by an overarching vision and objectives to achieve well-defined, specific targets. The following sections can support the development of such a strategic implementation approach.

5.1. Vision, objectives and targets

55. In the development of a restoration approach, it is of critical importance to integrate key stakeholders early on and define responsibilities among organisations, departments or other parties involved, to create a shared vision. Specific, well-defined restoration goals or targets must address degradation causes and consider not only ecological needs but those related to socio-economic and cultural aspects, and trade-offs between them [3]. The following definitions were adapted and elaborated from Nelson et al. (2024):

__A vision__ is a general statement of the desired state or outcome (e.g. environmental condition) towards which the strategy contributes.

__An objective__ is a clear statement outlining the desired short- and medium-term changes in the strategy's criteria that are essential for achieving the restoration targets. Objectives should adhere to SMART criteria: they must be specific, measurable, achievable, relevant, and time bound.

__A restoration target__ is an ecological, socioeconomic, or cultural element selected as a focal point of the recovery plan/implementation strategy and against which progress can be measured. Together, all targets should encompass the key elements of actions required to address threats.

56. Some of the best practice advice for designing these elements considers the following principles:

- Co-design with relevant partners, organisations, institutes and other stakeholders.
- Aim for both environmental and community benefits.
- Ensure targets consider short, medium and long-term achievements.
- Consider data availability, needs, and dependencies to track progress towards targets.

57. Therefore, recovery should consider both ecological (e.g., connectivity among populations) and social (e.g., business plan for long-term stewardship) objectives, which will reduce the risk of failures [23].

MED CONTEXT

The post-2020 SAPBIO proposes a long-term Vision for 2050: "By 2050, marine and coastal biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy Mediterranean Sea and coast, and delivering benefits essential for nature and people".

5.2. Timelines

58. Understanding both biological and policy timelines is crucial for recovery planning. There are several timelines to consider in a recovery plan:

- Recovery timelines (natural timescales)
- Administrative timelines (how long processes, approvals, etc. take)
- Action/implementation timelines
- Policy timelines (targets, processes, reporting obligations, etc.)
- Political timelines (government changes, budget approvals, elections, etc.)

59. Studies have shown that time to recovery varies between species depending on biology and circumstances, with recovery particularly challenging for long-lived species, species with small and fragmented populations and species with persistent threats [5]. Timing management interventions therefore becomes a critical component of recovery to avoid tipping points or thresholds and prevent species extinction [9]. Tipping points characterize an abrupt, rapid, and sometimes irreversible change in the ecosystem.

MED CONTEXT

The post-2020 SAPBIO stipulates that:

"By 2030, biodiversity values and related targets have been integrated into national and local development strategies and planning processes and are being incorporated into national policies, national accounting as appropriate, and reporting systems, ensuring that biodiversity values are mainstreamed across all sectors and integrated into the assessment of environmental impacts."

5.3. Success criteria

60. To determine whether species are recovering, and restoration goals are met, quantifiable criteria or indicators are required. Such indicators can relate to species-specific, biodiversity-related, environmental, social, or economic parameters that inform whether a recovery target is met [45,46]. Success criteria should be defined with stakeholders and set before any recovery actions are taken place. They will be informed and related to the pre-assessments of species' status, habitat condition, and threats. The 'success' of species recovery should consider both benefits to the species concerned and communities that interact or depend on it [2]. Quantifiable2 recovery criteria need to be determined for each of the species concerned in the recovery plan, although in some cases the same criteria might apply for multiple species. For example, indicators related to reduced fishing pressures could benefit more than one species concerned.

61. A general distinction can be made between criteria that measure parameters describing the species population status or ecological functions, and those that determine changes in threats (threat-based criteria). When defining objectives and targets (Section 5.1) it is important to determine what a 'recovered state' for each species is, considering that for some species full/ historic recovery may not be possible.

[2] The quantitative standard consists of three elements: a numeric threshold, defined units of measurement, and units that can be measured using standard scientific protocols. However, a quantitative threshold is meaningless if the units are not specified or if the specified units lack a clear definition.

62. A species might be considered 'fully recovered' if the population is viable, ecological functional, and representative [47]. There are three fundamental target conditions to the development of recovery criteria- the 3 R's[48]:

- **Resilience:** Local populations of a species are sufficiently large, genetically diverse, and well-balanced in terms of age and sex composition to withstand periodic threats such as heat waves, or disease.
- **Redundancy:** There are enough distinct populations of a species to ensure a buffer against the loss of some populations due to catastrophic events.
- **Representation:** There is enough genetic diversity among populations of a species to preserve the full range of its genetic makeup and maintain its ability to evolve and adapt to changing environmental conditions.

63. The assessment of each of these might be subject to differentiated, distinctly defined spatial units [47]. It also highlights the importance of genetic diversity in determining recovery success [49]. Restoring genetic diversity is a target under the Kunming-Montreal Biodiversity Framework and can be achieved through population recovery, which will simultaneously increase the species resilience to environmental change [49]. To integrate genetic diversity goals into recovery strategies and determine relevant criteria is therefore essential (Figure 6). See Box 11 for more advice.

Box 11: Framework to integrate genetic criteria and targets into national plans

Source: Hoban et al. (2024). How can biodiversity strategy and action plans incorporate genetic diversity and align with global commitments? Bioscience (2024). https://doi.org/10.1093/biosci/biae106

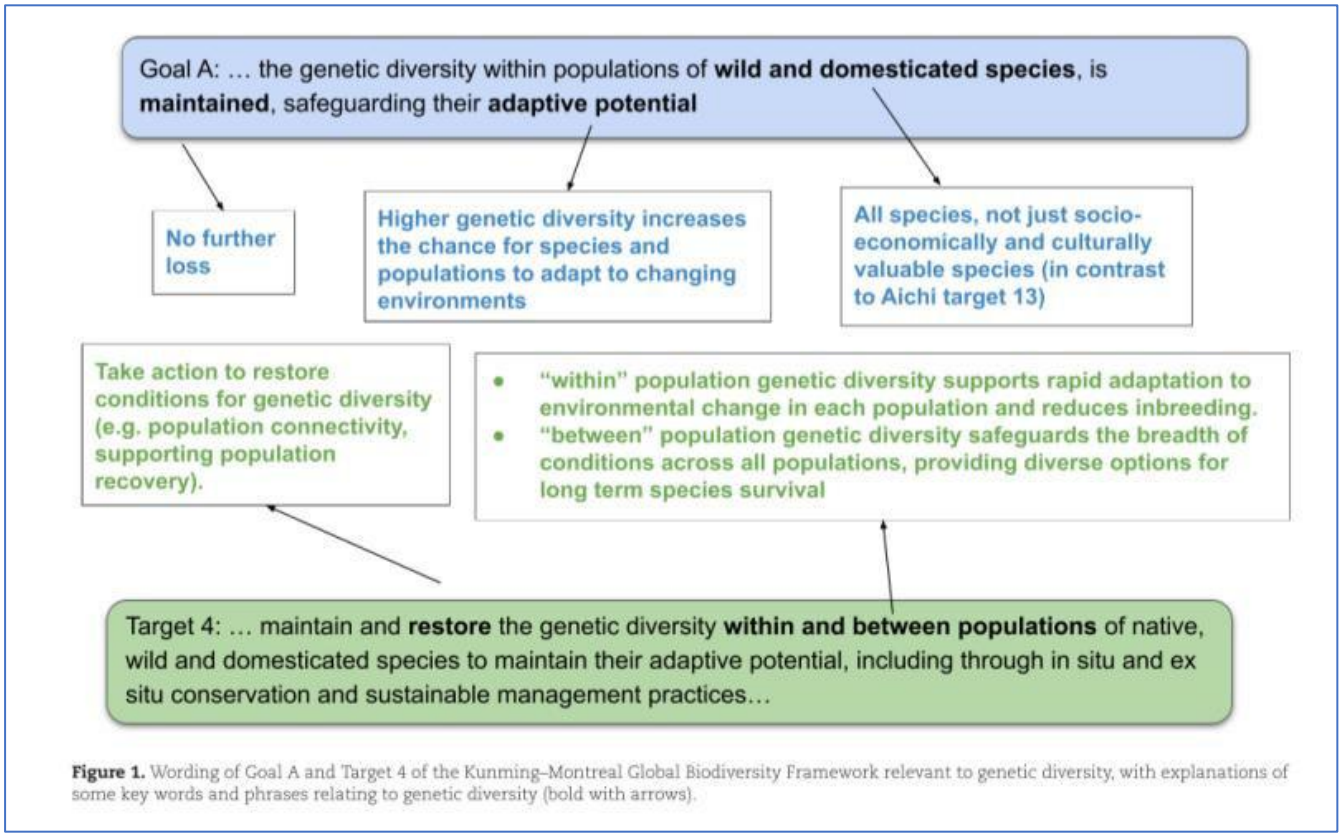

Figure 6. Requirements to maintain genetic diversity under the Kunming-Montreal Biodiversity Framework, based on Hoban et al. (2024)

64. Box 12 demonstrates an example for recovery criteria. There are increasing efforts to develop and apply a metrics-based system to measure species recovery. Metrics can have multiple applications and are being developed and tested to measure recovery progress considering threats, actions and future conditions [34,50]. Metrics can also assess spatial connectivity between habitat patches and thereby guide decision-making and monitoring [26]. An example of an applied metric for species recovery is the IUCN Green Status Framework which measures recovery progress using parameters like conservation legacy and recovery potential, and can support dynamic baselines and short-term conservation impact projections [37,47]. Furthermore, Figure 7 provides some criteria that could be measured in relation to recovery success.

Box 12: Example of criteria to determine ecosystem or species recovery:

Source: Maynard et al. (2015). Assessing relative resilience potential of coral reefs to inform management, Biol Conserv 192, 109–119. https://doi.org/10.1016/j.biocon.2015.09.001:

- Macroalgae cover
- Herbivore biomass
- Coral diversity and recruitment
- Bleaching resistance

4VP Principle	Potential Metrics	Threshold Values	Threat Criteria
Diversity	Unit of representation, based on ecological setting, or geographic area (ecoregion, watershed, etc.) Note: Can be called conservation, management or recovery units in the recovery plan under specific circumstances	• Number of units, and • Specify spatial distribution needed. • Amount of connectivity between units, if applicable (acreage)	Are there threats affecting representation for which amelioration is needed? If Yes—Identify the specific threat and the reduction in its level and extent needed to reach demographic– or habitat-based criteria.
Spatial Distribution	Number of resilient populations per representative unit	Number of resilient populations within each representative unit	Are there threats affecting redundancy for which amelioration is needed? If Yes—Identify the specific threat and the reduction in its level and extent needed to reach demographic– or habitat-based criteria.
	Distribution and connectivity of populations within the unit	Specify the distribution and connectivity of populations	
Abundance, Productivity, & Spatial Distribution	Population size	Number of individuals per population (over Y time period)	Are there threats affecting resiliency for which amelioration is needed? If Yes—Identify the specific threat and the reduction in its level and extent needed to reach demographic– or habitat-based criteria.
	Population growth rate	Value of Lambda	
	Age or size class distribution	Specify	
	Sex ratio	Specify	
	Survivorship	Specify	
	Genetic heterogeneity	Specify	
	Habitat quantity and quality	Acres and specified distribution of habitat; aspects of habitat quality needed	
	Connectivity among populations	Specify connectivity	
	Selected metrics that contribute to resiliency	Probability of persistence over Y time	

Figure 7.Potential metrics, threshold values and assessment criteria. Based on NOOA (2020)

65. Key to species recovery are actions that address the underlying threats that led and continue to contribute to the species' decline [20]. For each of the identified threats (see section 4.2.1) and related actions, measurable criteria must be defined. This includes both current and anticipated future threats. These threat-base criteria are inherently linked to the species demographic or habitat -based criteria to determine whether recovery progress has been achieved through threat-reduction or elimination. An analysis of how threats relate or interact with each other is also needed.

5.4. Barriers

66. No conservation or management intervention comes without its challenges and potential barriers that could hinder the achievement of recovery goals. Beside the highly dynamic, three-dimensional nature of marine systems, the implementation of restoration projects faces significant challenges. Marine ecosystem restoration faces environmental, technical, social, economic, and political barriers [12]. It is important to understand and assess these barriers before drafting a recovery plan. Some examples of existing barriers include:

- **Policy and legal barriers**: Inadequate legislative frameworks and complex regulatory and permitting frameworks hinder large-scale coastal and marine restoration projects [33,51].
- **Financing** remains a major hurdle, necessitating innovative approaches to fund activities sustainably [1,12,52].
- **Monitoring limitations:** Current monitoring systems often fail to detect nuanced progress, prompting calls for more robust metrics to evaluate conservation outcomes and be climate change considerate or adaptive [23,26,50].
- **Data Deficiencies and the unknown:** Conservation targets often rely on incomplete data, underscoring the need for better baseline data and dynamic assessment tools [37,53]. Furthermore, inconsistent data and a lack of knowledge sharing exacerbate these problems [33].
- **Implementation and alignment gaps:** Few systematic conservation plans are fully implemented [21], emphasizing the need for better alignment of plans with policy and funding structures [1]
- One of the biggest challenges that recovery actions face, and for which recovery plans must account for or be adaptive to, is **climate change** [9,12,23].

67. At European level, limited funding, conflicting stakeholder views and low political priority have hindered sufficient progress in ecosystem restoration efforts [54]. However, there are solutions to overcome existing barriers [13,23,24,33,34,41,55–58]:

- Co-designing projects with diverse stakeholders;
- Fit-for-purpose governance and funding models requiring cooperation between public and private sectors;
- Robust monitoring, and clear strategies to adapt to climate change;
- Collaborative efforts across local, national, and international levels are essential to align restoration priorities and leverage funding;
- Clear goals and benchmarks, considering ecological connectivity and long-term stewardship;
- Combining direct (planting) and indirect (biomanipulation) methods optimizes outcomes;
- Restoration tools must address climate-change resilience, such as restoring carbon-sink ecosystems like mangroves.;
- Standardised methods and transparent, systematic, and consistent reporting of restoration activities and outcomes.

68. In conclusion, recovery planning should identify barriers and find solutions. Overcoming barriers and challenges requires effective policy solutions, prioritization of restoration opportunities, public engagement, and restoration tools that integrate adaptation management for future climate scenarios. The success of restoration efforts depends on establishing clear governance structures, legal frameworks, and consistent funding, alongside active participation from local communities and scientists.

MED CONTEXT

The SAPBIO lists some critical barriers for biodiversity conservation in the Mediterranean, which are basically consistent across different assessments and include:

- The implementation of conservation and management related to marine species is lagging, often caused by resource and capacity limitations
- Political priorities do not sufficiently accommodate environmental issues and concerns
- Wide-ranging knowledge gaps remain

5.5. Actions

69. Independent of the scale of implementation, nature restoration and species recovery require a systematic approach. There are multiple considerations in the decision-making process to determine which is the best way to support a threatened species and ensure successful recovery. One way is 'Systematic Conservation Planning (SCP)', which offers a structured, step-by-step framework to prioritize biodiversity protection [29,59–61]. SCP ensures that social, economic, and ecological dimensions are integrated.

70. There is a general distinction between 'active' and 'passive' interventions. The former includes, for example, the planting of seagrass seedlings or installation of structures for reef recovery. Passive restoration on the other hand often refers to management interventions that allow a system to naturally recovery or restore itself through reducing pressures such as pollution or destructive fishing practices [53].

*A **recovery action** is a strategic management intervention that is prioritised and site-specific and aims to conserve, manage, protect, restore, enhance species and their habitats, as well as to minimise, reduce or eradicate any threats. Adopted from NOOA (2020)*

71. Each recovery action should have a defined starting point (the most recent status of a specific parameter of the species or threat), an endpoint (target condition/parameter), and a direction that defines specific activities required to achieve the endpoint. Such actions need to be:

- Balanced between social/cultural, commercial, developmental, political, resource security, livelihood and disaster mitigation values [45];
- Remain flexible and adaptive to changing conditions [20];
- Carefully positioned with respect to legislative frameworks and requirements, jurisdictional issues and legal expectations [45].

72. A tool widely used for conservation planning is Marxan, which enables optimized conservation site selection by balancing ecological goals with cost-effectiveness [29,60]. Another, emerging approach are natural capital assessments to support mapping and prioritizing opportunities for nature recovery, while also communicating the benefits and changes in ecosystem services [62,63]. Considering trade-offs and understanding the ecological context, potential outcomes, and risks are critical to ensure successful restoration [64,65].

73. Emerging research in marine restoration has also demonstrated new avenues to support recovery by considering, for example, Microbiomes [66]. Microorganisms are vital for ecosystem health, aiding in adaptation to climate change and enhancing food web efficiency (Figure 8). Microbiomes, including the selection of probiotics and bio-promoters, can influence habitat recovery and guide restoration efforts [66]. A microbiome-approach can be used to support:

- **Coral Health**: Engineering coral microbiomes can improve heat tolerance and resilience against ocean warming, highlighting its potential in coral restoration. manipulating microbiomes to enhance resilience and recovery (e.g., heat tolerance in corals) offers innovative approaches to ecosystem restoration.
- **Deep-Sea Restoration**: Microbiome understanding could be key to overcoming challenges in deep-sea habitat restoration, where technology and costs are significant barriers [67].
- **Future Directions**: Exploring microbiome modulation for larger-scale transplantation success, especially for seagrass, is still under research.

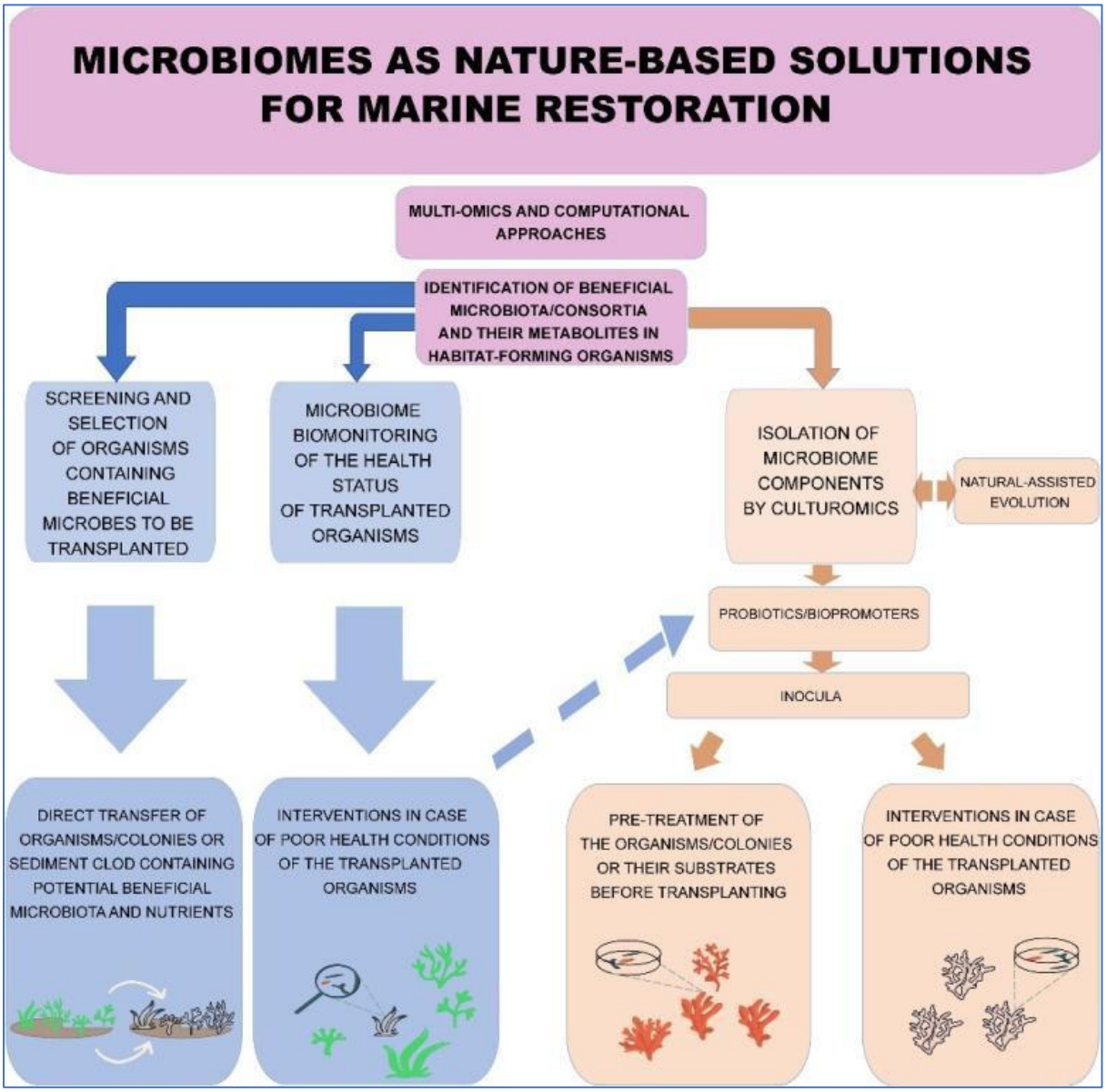

Figure 8. The application of microbiome-assisted restoration planning by Corinaldesi et al. (2023)

74. The threat assessment (section 4.2) helps to identify necessary actions to address pressures and support species recovery. Recovery actions should consider the species' current condition and anticipated future challenges, to guide progress towards recovery. The status review also provides insights into the relative impact of threats, helping to prioritize actions and their effectiveness.

75. Recovery actions must be prioritized to ensure efficient and effective implementation and should be combined across multiple species whenever feasible to enhance effectiveness. A possible framework to follow in determining the recovery approach is presented in Figure 9.

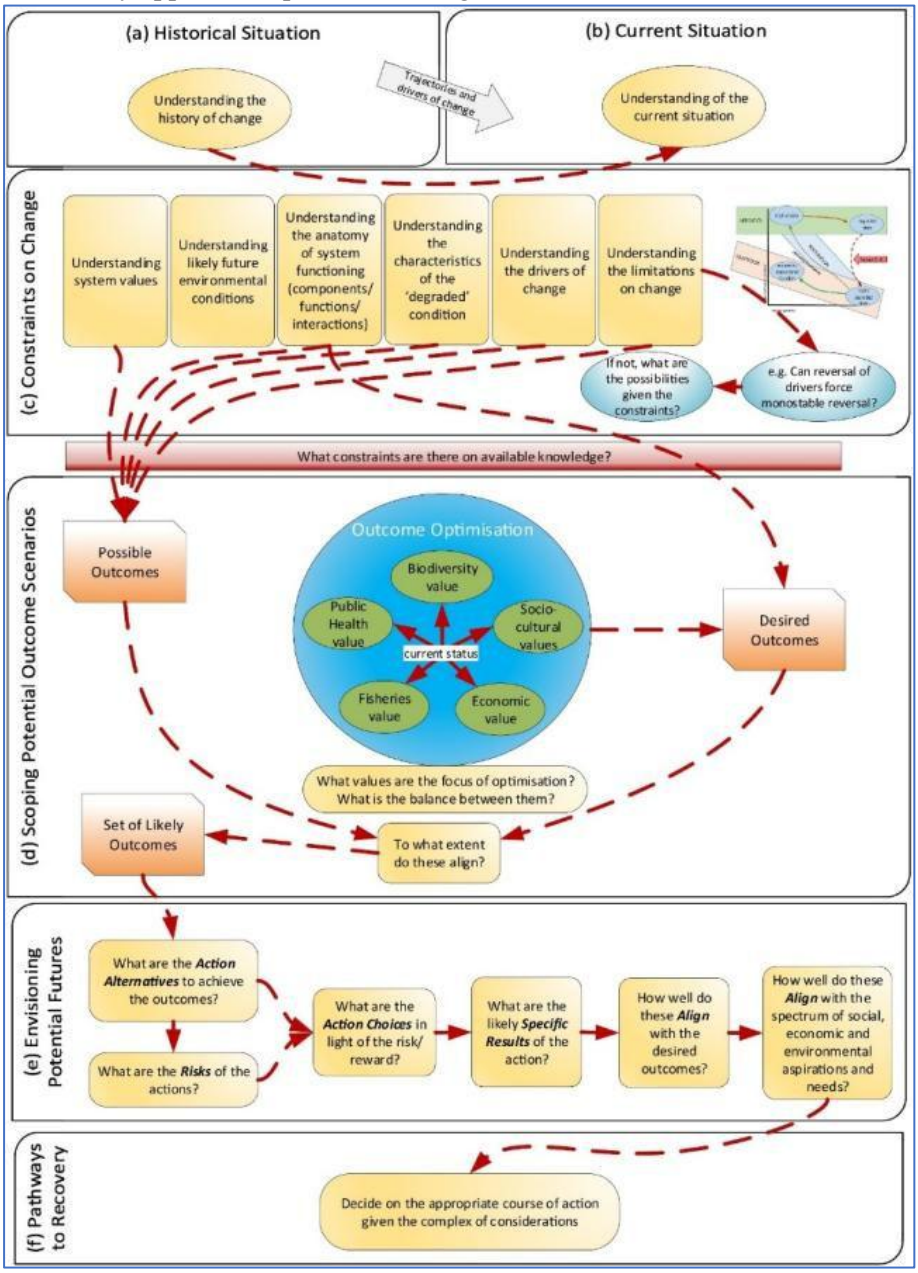

Figure 9. Decision framework for optimised restoration by Sheaves et al. (2021). This involves (a) understanding the historical situation (scientific, cultural and economic) (b) understanding the current situation, (c) understanding the constraints on change, (d) scoping possible outcome scenarios, (e) envisioning potential futures and, finally, (f) making knowledge-informed decisions on actions to manage risk versus reward.

76. Scenario modelling can be a powerful tool to identify the right course of action and for enhancing communication among scientists, practitioners, and decision-makers, thereby supporting informed policy and management decisions [68]. Scenarios can help to answer three fundamental questions:

- What are the possible outcomes?
- Which outcomes are likely to eventuate?
- Will the outcomes live up to expectations? [45].

***Models** are simplified representations of real systems, which can be qualitative or quantitative, capturing specific components of systems and their relationships. In ecological restoration, models play a crucial role in linking restoration-induced changes in ecosystem structure to their resulting effects on ecosystem functioning, particularly the provision of ecosystem services. Adopted from Sheaves et al. (2021)*

***Scenarios** are versions of potential futures for one or more system components, focusing on drivers of change in nature and resulting benefits, as well as alternative policy and management strategies. Adopted from Metzger et al. (2017)*

77. A potential tool for scenario modelling is a Population Viability Analysis (PVA) that employs quantitative methods to forecast the future status of a population of conservation concern [69]. It often estimates the probability of the population going extinct within a specified timeframe. Additionally, like other models, PVA can be used to evaluate and compare the potential outcomes of different management strategies [37,69]. Box 13 provides more insights on how to build and use scenarios for restoration planning.

Box 13: Best practice guidance for the use of scenarios

Source: Metzger et al. (2017). Best practice for the use of scenarios for restoration planning. Current Opinion in Environmental Sustainability, 29, 14-25. https://doi.org/10.1016/j.cosust.2017.10.004

MED CONTEXT -examples of restoration efforts and guidance

ROC-POP-LIFE (2017-2021) project. Promoting biodiversity enhancement by Restoration of Cytoseira Populations.

Cebrian et al. (2021). A Roadmap for the Restoration of Mediterranean Macroalgal Forests. Front. Mar. Sci. 8:709219. https://www.frontiersin.org/articles/10.3389/fmars.2021.709219/full

Smith et al. (2023). A decision-support framework for the restoration of *Cystoseira sensu lato* forests. Front. Mar. Sci. 10:1159262. https://www.frontiersin.org/articles/10.3389/fmars.2023.1159262/full

De Wit & Boutin (2023). European LIFE Projects Dedicated to Ecological Restoration in Mediterranean and Black Sea Coastal Lagoons. Environments, 10(6), p. 101. https://doi.org/10.3390/environments10060101.

REEForest (2022-2026) project. Restoration of Cystoseira macroalgal forests to enhance biodiversity along Mediterranean rocky reefs.

EFFECTIVE (2023-2027) project. Enhancing social well-being and economic prosperity by reinforcing the

Time, cost estimates and socio-economic assessment

Box 14: Example of financial benefits

Source: Fuchs & Stelljes (2022). Why is Nature Restoration Critical for Marine Areas. https://www.ecologic.eu/sites/default/files/publication/2023/fuchs-23-nature-Restoration-and-marine-areas.pdf

"Estimated economic benefits of restoring seagrass beds range between €284 and €514/ha/year; for shellfish, mussel and oyster beds, they are estimated between €5,000 to €90,000 per ha per year."

78. Each action and relevant steps/ activities should include an estimated time and associated costs. This will guide the determination of the overall budget required to achieve species recovery and support the socio-economic analysis of action implementation. A socio-economic analysis consists of both costs and (potential) financial benefits resulting from an action. While precise cost-benefit analyses are often challenging due to a lack of baseline data, evidence suggests that the benefits (see Box 14) of restoring marine ecosystems outweigh the costs [53]. Although some economic sectors may experience short-term losses, these are likely offset by long-term gains. Fisheries, for example, stand to benefit from increased catches over the medium to long term as a result of restoring essential fish habitats [53]. More information on approaches to calculate costs and benefits of restoration is given in Box 15.

Box 15: Additional reading on cost-benefits analyses for marine restoration

Source: Sumaila (2004). Intergenerational cost–benefit analysis and marine ecosystem restoration. *Fish and Fisheries*, *5*(4), 329-343. https://doi.org/10.1111/j.1467-2679.2004.00166.x

Source: Logar et al. (2019). Do the societal benefits of river restoration outweigh their costs? A cost-benefit analysis. Journal of environmental management, 232, 1075-1085. https://doi.org/10.1016/j.jenvman.2018.11.098

Source: Tonin (2019). Estimating the benefits of restoration and preservation scenarios of marine biodiversity: An application of the contingent valuation method. Environmental Science & Policy, 100, 172-182. https://doi.org/10.1016/j.envsci.2019.07.004

Source: Chen et al. (2022). Ecosystem service benefits and costs of deep-sea ecosystem restoration. Journal of Environmental Management, 303, 114127. https://doi.org/10.1016/j.jenvman.2021.114127

Source: Crookes (2023). Fisheries restoration: Lessons learnt from four benefit-cost models. *Frontiers in Ecology and Evolution*, *11*, 1067776. https://doi.org/10.3389/fevo.2023.1067776

Implementation schedule

79. An implementation schedule or equivalent table can organize recovery actions, priorities, timelines, costs, and implementing partners in a clear, visual format. While this is an optional part it is considered 'good practice', as it aids in tracking progress, reporting accomplishments, and uploading data into a database for national reporting. Key elements of an implementation schedule include:

- Recovery actions and their priority ranking
- Likely implementers (e.g., agencies, stakeholders, partners)

- Estimated duration for each action
- Estimated costs for implementation

Re-introduction or translocation of species

80. A special case of species recovery actions includes the translocation or re-introduction of species. In 2013, the IUCN published a guide for the re-introduction of species, which heavily focuses on terrestrial conservation efforts [70]. In relation to the marine environment, there has been lesser progress and experiences in this matter, and it is still an evolving field.

MED CONTEXT

Scientists have, for example, tried to develop improved approaches to move one of the most threatened species, the Mediterranean ribbed limpet (*Patella ferruginea)*, during low activity periods (low tide) and with limpets still attached to their home scars on breakwater boulders, resulting in an 87% survival rate [71]. Another example is presented in section 13 for red coral, *Corallium rubrum*. Current discourses of restoration of threatened species, such as the fan mussel *Pinna nobilis*, which experienced a mass mortality in past few years, have demonstrated that both active and passive interventions at a regionally coordinated level are needed to combat increasing pressures and prevent species extinction [89].

6. Governance structure (roles and responsibilities) and ongoing management

81. Scaling up nature restoration will be impossible without a concrete convergence among scientists, private sectors, and stakeholders leading to a shared vision to maximize synergies and avoid trade-offs between priorities for restoring biodiversity, mitigating threats, and adapting to climate change. In this process, it is also important to share lessons learned from both successful approaches and failures. See Box 16 for examples.

Governance *encompasses both formal institutions, such as legal and regulatory systems, and informal institutions, including social structures, community organizations, and the practices and traditions of Indigenous Peoples. Adopted from Nelson et al. (2024)*

Box 16: Examples of different governance approaches for restoration

Source: van Tatenhove et al. (2021). The governance of marine restoration: insights from three cases in two European seas. Restoration Ecology, 29, e13288. https://doi.org/10.1111/rec.13288

82. Cross-disciplinary recovery teams are best able to achieve the goals of a recovery plan. One aspect that has received lesser attention in the literature is cross-country collaboration and cooperation, which will be required for migratory species. In the end, species recovery is a shared responsibility and should be a collective effort across agencies, governments, companies, NGOs, etc., to lead to effective implementation and long-term outcomes that secure any positive changes. Therefore, it is imperative to create opportunities for public-private partnerships and market-based incentives for businesses and individuals within restoration initiatives.

6.1. Engaging with stakeholders throughout

83. Stakeholder engagement is a core part of nature recovery and has been mentioned across guidance and planning advice [5]. There is a general agreement that early and consistent integration and engagement of key actors, and the support and advice of social scientists are important and crucial in nature recovery [5,68]. Incorporating social science ensures that conservation planning aligns with community needs and considers human dimensions, improving stakeholder buy-in and long-term success [72]. Furthermore, social science can help to build partnerships for the successful delivery of restoration activities [72,73]. Another consideration is to prioritise stakeholders and determine who should be involved in which step. One may distinguish between ‘key’, ‘involved’, and ‘considered’ stakeholders.

Key stakeholders *are individuals or institutions with a direct stake in the restoration process, such as government agencies responsible for policy implementation (e.g., signatories to the CBD and Aichi targets). They are the ones who initiate the process. Adopted from Metzger at al. (2017)*

Involved stakeholders *are individuals or institutions that influence restoration scenarios through their direct actions at restoration sites or by being affected by the outcomes of those scenarios. Adopted from Metzger at al. (2017)*

Considered stakeholders *are individuals or institutions who may not have a direct interest in or need to participate in the development of restoration scenarios, nor the ability to influence them, but could still be directly or indirectly affected by the restoration efforts. Adopted from Metzger at al. (2017)*

84. Determining who belongs to which group depends on the recovery actions planned. It is important to understand how stakeholders operate, organise themselves and understand their roles in environmental management and, more specifically, the recovery of the species. Stakeholder engagement should be broad enough to understand conflicts and interests of different parties with the aim to aid and speed up recovery. Some best practices for stakeholder planning and engagement are:

- Draw a plan early on.
- Define a list of stakeholders and group them.
- Tailor ways of communication and outputs.
- Be inclusive.
- Communicate in a transparent and clear manner.
- Listen carefully to what stakeholders have to say.
- Respond to queries and questions quickly and follow up.

Box 17 presents some important questions to be answered to determine how to engage stakeholders.

Box 17: Key questions to determine stakeholders (adopted from NOOA, 2020):

- Who depends on the species or habitat the most?
- Who has the biggest interest in the species' recovery?
- Who represents people likely to affect or be affected by the recovery process?
- Who has already been affected by measures taken for this species?
- Who can support the achievement of recovery goals, objectives, and criteria?
- Who should be responsible for the implementation of recovery actions?
- Is there anyone who has rights or claims over required resources or spaces?
- Who has information or knowledge that is required? is most knowledgeable about, and capable of dealing with, the resource issues?
- Who could impact the recovery? specifically is having an impact on the conservation of the species?
- Is there anyone who has been involved in previous or current management or conservation of the species or respective habitat(s)?
- Have there been previous stakeholder events from which you can learn?
- Who might be against the recovery actions?
- Who could provide financial support or technical expertise?

85. There are various ways of how to communicate, involve or engage with stakeholders and those need to be explored and planned during the drafting stage of the recovery plan to ensure that this component aligns with the implementation of actions and subsequent monitoring.

86. Methods for involving stakeholders may include one or more (or a combination) of the following:

- Direct engagement and feedback through interviews, questionnaires or focus groups.
- Activity-based approaches such as drawing, games, workshops, or art-based activities.
- Data-based approaches including scenario development, participatory mapping media analysis, gap analysis, network analysis or human capital accounting.
- Capacity building including training and teaching and technology development.

Box 18: Some lesson's learned from stakeholder engagement in Marine Spatial Planning

Source: https://www.mspglobal2030.org/resources/key-msp-references/step-by-step-approach/engaging-stakeholders/

87. More insights from best practices are presented in Box 18 and key considerations for effective stakeholder engagement are summarised in Box 19.

Box 19: Key considerations for effective involvement of stakeholders

- Are there any obstacles to engage with specific stakeholders (e.g. literacy, disabilities, access, etc.)
- Are there special needs of stakeholders to be able to attend meetings, workshops, focus groups etc.?
- What is the best way to communicate/reach certain stakeholders?
- How regular do you need to engage with stakeholders
- What is the information or involvement you need from stakeholders?
- How do stakeholders want to be involved?

6.2. Partnerships

88. Another, often underestimated aspect, is establishing partnerships for various aspects of the recovery process. The most influential and supportive organisations, entities, companies or individuals could help to achieve recovery goals quicker, if they take direct responsibility for the delivery of certain activities or provide the required resources through partnerships. Partnership building has become a cornerstone for successful marine conservation and management whether in form of co-management, co-governance or shared resources [74,75]. Such partnerships could consider:

- Co-design and co-management recovery actions.
- Coordinated and shared responsibility of recovery actions.
- Financial partnerships.
- Combined monitoring efforts.
- Partnerships to engage and involve stakeholders.

MED CONTEXT

There are several existing partnerships in the region that can support restoration. SPA/RAC works closely with partner organisations such as the IUCN Med and WWF Mediterranean Programme, as well as the MedPAN network and the private-public donor trust fund (The MedFund). The Med Sea Alliance and the Union for the Mediterranean are other consortiums that offers support.

See also:
European Commission (2023). Harnessing the power of collaboration for nature-based solutions: New ideas and insights for local decisionmakers. Publications Office of the European Union, 2020, https://data.europa.eu/doi/10.2777/954370

7. Risk assessment and management

89. An essential part, informed by the analysis of existing and future barriers to implementation, is a comprehensive risk assessment and management plan. Risk assessments or analyses evaluate the likelihood of undesirable events and their potential consequences. They play a crucial role in prioritizing management actions and analysing trade-offs, making them a vital part of ecosystem-based management. For a recovery plan such an assessment should evaluate ecological, cultural, socioeconomic and legal risks associated with recovery activities.

90. A risk matrix is a powerful visual tool designed to identify, assess, and prioritize risks within a business or project. Also referred to as a risk assessment matrix, risk control matrix, or risk analysis matrix, it provides a structured approach to risk management (Figure 10).

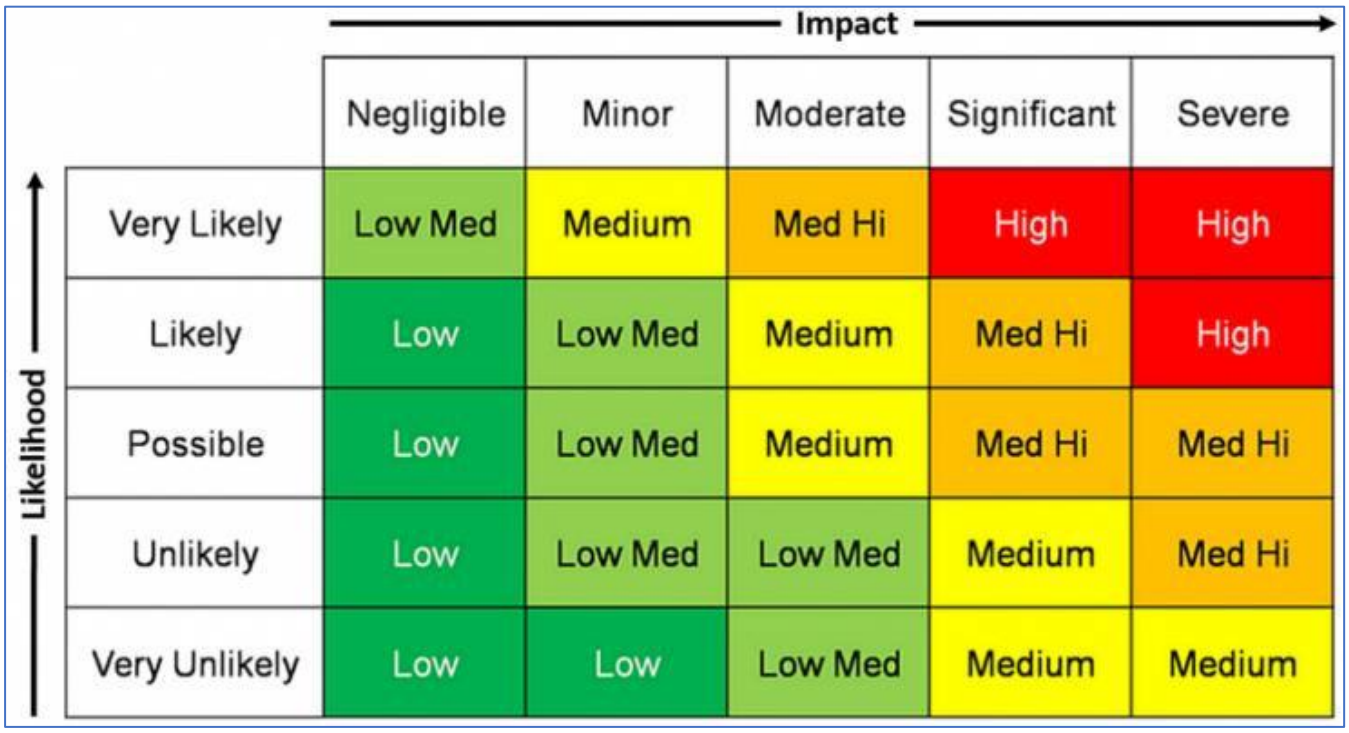

Figure 10. Traditional risk matrix rating existing and potential risks based on impact and likelihood of occurrence from low to medium to high risks.

91. The matrix is built around two key dimensions:

- **Likelihood**: The probability of an event occurring.
- **Severity**: The magnitude of the event's potential consequences.

92. Risks are plotted on a grid where each cell corresponds to a specific risk scenario. The grid is typically color-coded (Red: High risk; Yellow: Medium risk; Green: Low risk). Key Applications of a risk matrix include:

1. **Informed Decision-Making**:
   Organizations can utilize the matrix to prioritize risks, allocate resources efficiently, and implement effective control measures.
2. **Ongoing Risk Monitoring**:
   Serving as a dynamic risk register, the matrix enables teams to track and reassess risks throughout the duration of a project.

3. **Enhanced Project Outcomes**:
   By minimizing the impact of risks, the matrix increases the likelihood of successful project completion.

93. Additionally, a risk register, a structured document or table, is needed. A risk register contains details on each risk assessed and actions taken. Risks are evaluated before and after such action to determine whether the significance of the risk has changed to a lower rating. The register is a living document that needs to be kept up to date to monitor risks and act accordingly.

94. An emerging best practice principle for assessing risks is the integration of cumulative effects, as shown in Figure 11 [76–78]. As with other parts of the recovery planning process, a risk assessment should integrate different stakeholders, their knowledge, information and views and proposes solutions for risk aversion or mitigation.

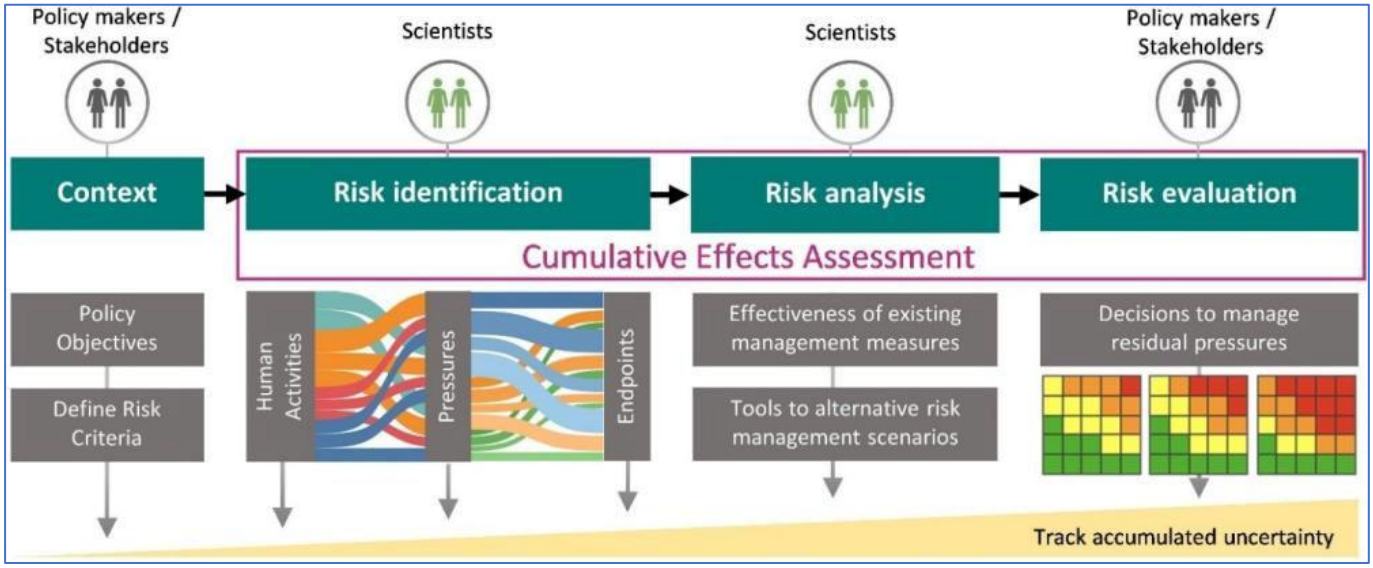

Figure 11. Integration of cumulative effects into risk assessment. Source Katsanevakis, et al. (2020)

95. A comprehensive risk assessment and respective management approach to monitor, mitigate and/or treat existing or evolving risks requires expertise and capacities that need to be determined. Box 20 presents key questions to be answered in the risk assessment process.

Box 20: Key questions for a risk assessment and management plan

- Are all risks accounted for?
- Have stakeholders been consulted to help identify and review risks?
- Have risk categories been reviewed and checked
- Have actions to mitigate or reduce risks been identified and determined
- Is someone in charge to administer the risk register and update it?
- Has an agreed location to store the register been allocated (online, paper format, etc.)?
- Have review intervals been determined?

8. Monitoring and evaluation

96. Monitoring is another key part of species recovery and needs to be well-planned with specified criteria to measure recovery progress and success and watch potential threats. But monitoring is not only defined by the agency responsible for recovery (Figure 12), as it should be a transparent and integrative process inclusive of multiple views from key actors [57].

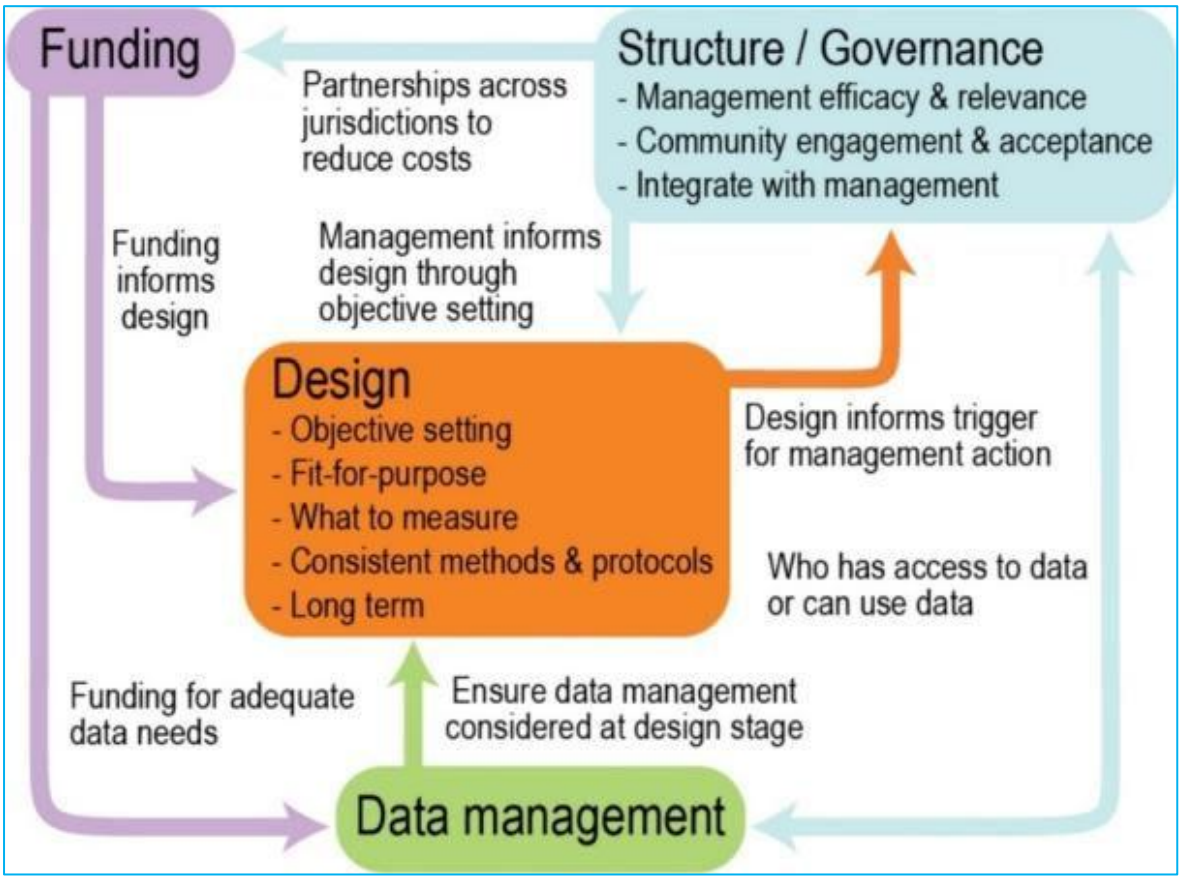

Figure 12. Structured approach to define an integrative monitoring programme for restoration by Lindenmayer et al. (2020)

97. The monitoring programme for species recovery should consider multiple aspects:

- Species monitoring.
- Implementation monitoring – recovery criteria.
- Threat monitoring.
- Risk monitoring.

98. Some advice and tools are available, as shown in Box 21.

Box 21: Tools and applications for ecosystem restoration monitoring

Source: https://www.decadeonrestoration.org/publications/tools-and-applications-ecosystem-restoration-monitoring

99. A dedicated monitoring and evaluation plan should be developed, including procedures, schedules and budgets. Based on the data of these monitoring programmes, the responsible entity for the plan's implementation should evaluate recovery progress and adapt management accordingly. Box 22 summarises some key aspects for monitoring programmes.

Box 22: Key aspects to consider when designing and conducting a monitoring regime

- Monitoring components/criteria
- Frequency of monitoring
- Who is conducting the monitoring (e.g., associated research, consultants)
- Are there existing monitoring or research programmes that could be used or support the required data collection
- What are the costs for monitoring
- Evaluation method and criteria are clear and well-defined

MED CONTEXT

Existing region-wide data collection processes and standards for the region include:

- EU CFP, GFCM and ICCAT fisheries data collection processes, including trawl surveys such as the MEDITS programme
- EU data collection processes for the EU Directives (Habitats Directive, Birds Directive, Marine Strategy Framework Directive)
- Integrated Monitoring and Assessment Programme (IMAP)
- GFCM, ICCAT, STECF stock assessments

See also:

Hering et al. (2023). Securing success for the Nature Restoration Law. Science, 382(6676), 1248–1250. https://www.science.org/doi/10.1126/science.adk1658 :

The paper outlines various options for utilizing data produced under the Habitats Directive, the Birds Directive, the Water Framework Directive, the Marine Strategy Framework Directive, the Biodiversity Strategy, the Forest Strategy, the Common Agricultural Policy, and the Common Fisheries Policy in the implementation of the NRL.

9. Financing

100. Restoration projects are costly, risk-prone, and require extensive upfront investment. It is estimated that marine recovery will come at greater costs than terrestrial approaches [12,67,79]. A key consideration that can determine success or failure for recovery and restoration are therefore sufficient financial resources. Allocating sufficient funding to support adaptive management, as well as any necessary adjustments to the restoration plan, implementation efforts, and monitoring and evaluation processes is crucial. Traditionally, public funding would bear most of the costs of environmental conservation and restoration, but emerging funding opportunities and alternative funding models are becoming available to make funding restoration a more collaborative and shared responsibility [52]. Emerging solutions include blended finance models, which combine public, philanthropic, and private funding, to mitigate risks and attract commercial capital. Finance solutions must evolve to meet the varying needs of restoration efforts over time. Figure 13 demonstrates risks and barriers and how financial means can be mobilised during different phases of a restoration project, based on the guidance published by the World Bank [52].

101. Key drivers for the development of new finance solutions for restoration are net-zero targets, operational improvements, and new business opportunities. Corporate sustainability targets and nature-positive initiatives offer pathways for company investments in nature restoration. However, to get these funders on board, an improved understanding of ecosystem risks and opportunities is required. While the public might invest in species recovery [80], their willingness to fund recovery efforts varies by species, indicating economic differences in the perceived value of different marine species [80].

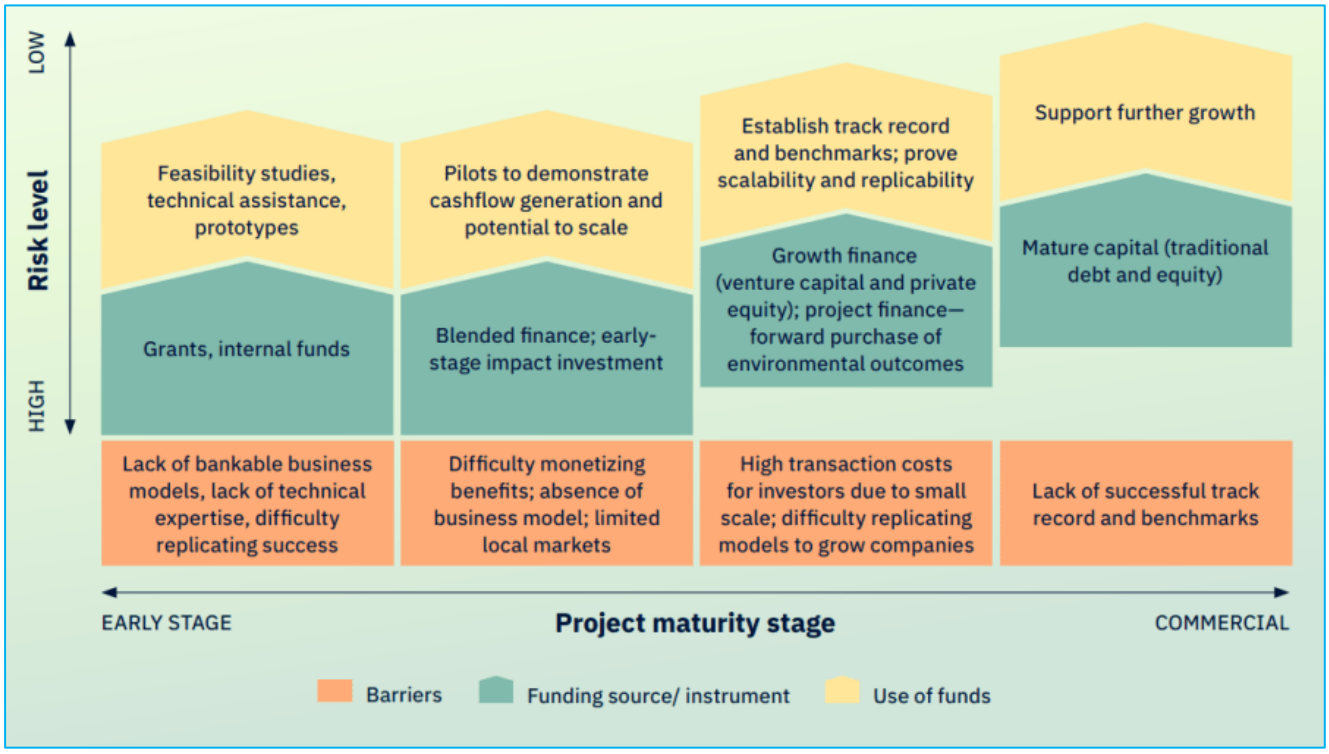

Figure 13. Scheme demonstrating private finance mobilisation during the different stages of a restoration project. Source: World Bank (2024)

102. There are a couple of key points for restoration financing based on the World Bank's assessment [79]:

- **High costs, high benefits**: While marine restoration is costlier per unit area than terrestrial restoration, the potential ecosystem service benefits justify the investment [62].

- **Private Sector Role**: Collaborative financial models and policy support are essential for scaling restoration.
- **Sustainable funding mechanisms** are critical, such as payment for ecosystem services and market access for restoration-derived products.
- **Long-term success relies** on private-public co-financing and value-chain development.
- **Restoration is no longer solely public sector led;** private sector investment is viable and critical.
- **Align investments** with global biodiversity frameworks for long-term recovery.
- **Blended finance, aggregators, and adaptive financial models** can address funding gaps.
- **Strong partnerships** with local governments and communities mitigate business risks and ensure sustained outcomes.
- **Policy signals**, such as incentives or penalties, play a crucial role in driving investment in ecosystem-friendly practices. Including community buy-in both are vital for scaling restoration efforts.

103. These financial aspects underscore the importance of strategic partnerships, innovative funding models, and enabling policies to mobilize private investment at scale for ecosystem restoration. Figure 14 shows actions to be taken to increase private investment.

MED CONTEXT

Insufficient funding has been a consistent obstacle in Mediterranean countries, especially in Southern and Eastern Mediterranean areas. The SAPBIO aims to develop sustainable funding strategies by 2027 to increase region-wide funding by 2030 from all sources.

- **EU LIFE Program**: Supports species recovery projects in Mediterranean EU countries.
- The EU Biodiversity Strategy for 2030 calls on unlocking 20 billion EUR/year for biodiversity conservation through various sources, including EU, national and private funding, and integrating biodiversity considerations into business practices.
- **Global Environment Facility (GEF)** and **Green Climate Fund (GCF)**: Provide international funding for biodiversity restoration and species recovery efforts.
- Regional and national funding through initiatives like the *MedFund*, supporting marine protected areas (MPAs) and species conservation.

Figure 14. Key actions to increase private funding involvement in restoration, from World Bank (2024).

10. Policy alignment

104. Policy alignment refers to the evaluation and adaptation of species recovery in the context of existing processes and policies. There are four main aspects of policy alignment to consider for a recovery plan:

- National policies that prevent recovery actions to be implemented or extend the time it takes to do so (e.g. licensing or permitting requirements, local land ownership, existing rights to resources etc.).
- New policies needed to enable the recovery process.
- The alignment of national strategies and policy goals across existing and developing strategies for, for example, National Determined Contributions, National Biodiversity and Action plans, national fisheries management.
- Alignment or recovery plans with existing regional Action plans, fisheries management, etc.

105. With increasing obligations to combat the triple planetary crisis of biodiversity loss, climate change, and pollution, countries should, as far as possible, align and combine actions. This also includes the adaptation of existing administrative processes to enable both active and passive restoration approaches. For example, some guidance on how to determine which permitting approach to apply for different risks categories is provided in Figure 15 [51].

Permitting categories identified for marine ecosystem restoration projects from the literature and some of the potential advantages and disadvantages for restoration practitioners identified for different permit category mechanisms for marine ecosystem restoration.

Permit categories	Potential advantages	Potential disadvantages
Development permitting process	High level of oversight (e.g. for novel techniques or for proponent with limited capacity)	Time and resource intensive
	Can help facilitate best practice techniques	Inappropriate legislative framework (focus on limiting negative impacts rather than facilitating positive impacts)
Multi-agency agreements	One permit for all agencies	Potentially only feasible for large-scale restoration projects
	Streamlined permit process for project proponent	
	Shorter approval timeframes	Greater resourcing required for lead agency to facilitate multi-agency agreements
	Requires prolonged cooperation between agencies	
Specific permit type	Policies more likely to facilitate restoration	Often multiple individual permits, through multiple agencies
	Risks to existing assets may be assessed in greater detail	Complex and time/resource intensive
Exempt from permitting	Restoration not limited by regulation	Limited oversight
	Reduced time delays and transaction costs to project proponents	Difficult to ensure best practice or long-term monitoring/management

Figure 15. Permitting options for different marine restoration approaches. Source: Shumway et al. (2021)

106. Section 2 offers an overview of existing policies at international and regional level for which national frameworks should be aligned and adapted to. National strategies such as marine spatial plans, national determined contributions to combat climate change and reduce carbon emissions, national biodiversity

strategies, species management plans, and fisheries plans should be working in synergy, supporting overall management and protection of marine resources and ecosystems.

MED CONTEXT – examples of existing policies and frameworks

2024 ICCAT Recommendation 16-0: Mediterranean swordfish fishing plans

2023: GFCM Recommendation 46/2023/16 on a long-term management plan for European eel in the Mediterranean Sea

EU- wide restoration plan under the 2030 Biodiversity Strategy

INTERREG (2022). Preserving and restoring biodiversity. A policy Brief from the Policy Learning Platform on Environment and resource efficiency.

2017: Conceptual Framework for Marine Spatial Planning (MSP) for the implementation of the Ecosystem Approach Roadmap

Regional action plans under the SPA/BD Protocol:

- Regional strategy for the conservation of Monk Seal in the Mediterranean
- Action Plan for the conservation of marine turtles
- Action Plan for the conservation of cetaceans
- Action Plan for the conservation of marine vegetation
- Action Plan for the conservation of bird species listed in annex II of the SPA/BD Protocol
- Action Plan for the conservation of cartilaginous fishes (Chondrichthyans) in the Mediterranean Sea
- Action Plan concerning species introduction and invasive species
- Action Plan for the conservation of the coralligenous and other calcareous bio-concretions in the Mediterranean Sea
- Action Plan for the conservation of habitats and species associated with seamounts, underwater caves and canyons, aphotic hard beds and chemo-synthetic phenomena in the Mediterranean Sea (Dark habitats Action Plan)

2008 Integrated Monitoring and Assessment Programme (IMAP)

11. Administration, plan review, updating and adaptation

107. Regular monitoring and updates to restoration maps and plans ensure accountability and progress tracking. Adaptive management is a circular approach, key to successful implementations and provides a feedback loop to implement, evaluate, and adjust management actions until a desired goal has been achieved (Figure 16).

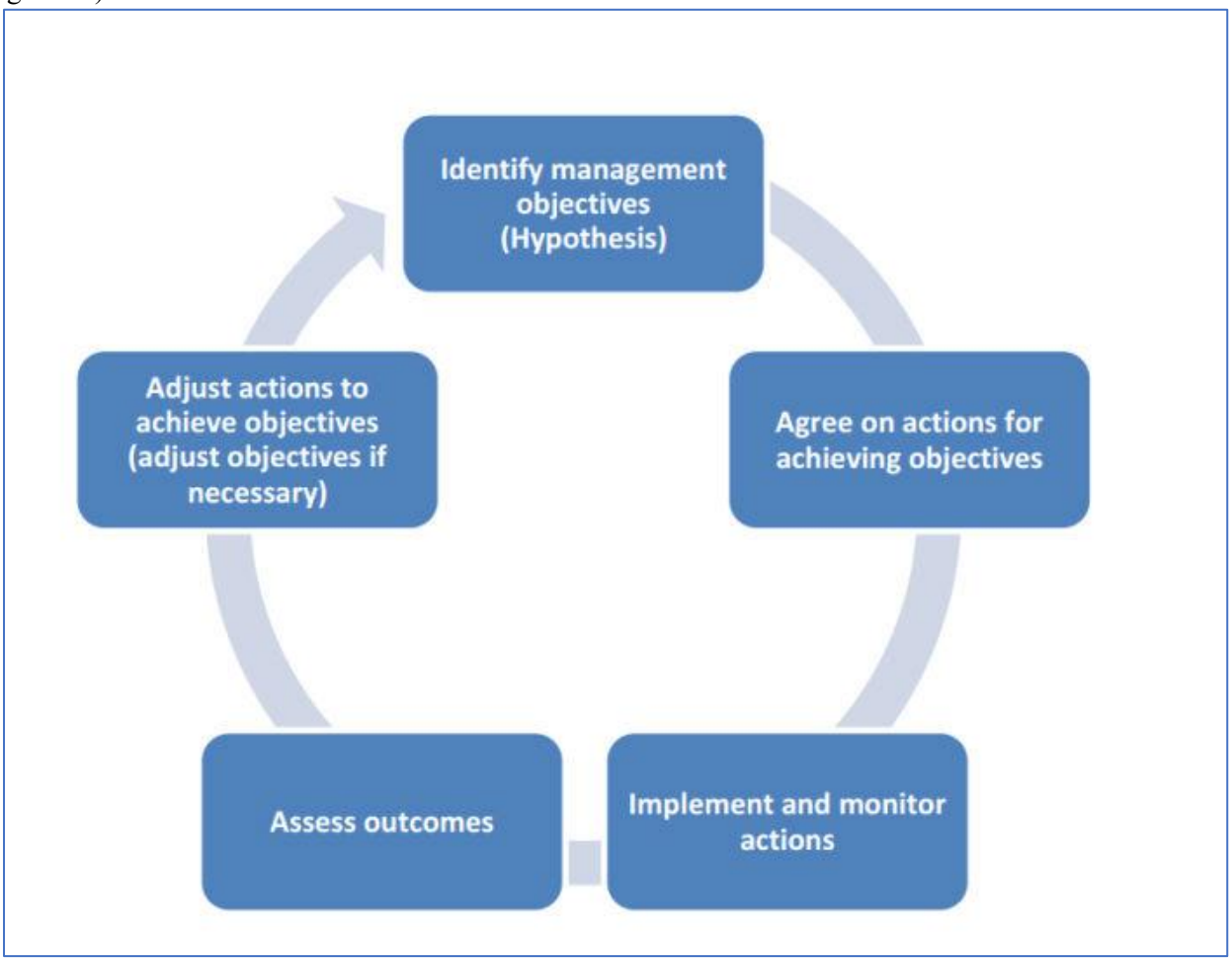

Figure 16. Adaptive management

108. The administration of a recovery plan requires some consideration on several aspects of reporting, record keeping, and communications, as well as adaptation, revision and updating of the plan, or parts of it. Table 1 provides an overview of changes and required actions to the recovery plan.

Table 1. Changes to relevant aspects of the recovery plan and required actions.

Type of change	Action needed
Species status changed/has been updated due to new information or assessments	Update
Results of ongoing and plan-related research and monitoring	Update
Minor grammatical errors and content corrections such as format corrections, typographical errors, updated citations, clarification of terminology, etc.	Update
Updates, adaptations and changes to the delivery of recovery actions and work plans detailing proposed projects, priorities, etc.	Update
Revised recovery actions including changed or new actions and amended costs, etc.	Revision
New or Revised Research, Monitoring and Evaluation Plan and/or Adaptive Management Framework	Revision

Improved understanding, greater detail, new or changed threats or barriers and/or change in prioritisation of such	Revision
Changes in recovery criteria that change the direction of the recovery effort	Revision
Updated scenarios due to new information on species, threats, actions, etc.	Revision
Revised goals or targets due to changes in species status, policy decisions or other causes	Revision
Adding to or amending an existing plan to incorporate another species	Revision

109. The recovery plan should determine a schedule following which the plan should be evaluated, updated and revised in specified intervals over the duration of the entire plan. This is the responsibility of the entity or individual in charge of the recovery plan and or a specified person/entity. Furthermore, the plan should determine how records are kept and who has access to these records. This might be in paper form or digital, on a secured server online or shared location. Box 23 highlights some key points for administering a recovery plan.

Box 23: Key aspects for plan administration

- Person or team responsible for administration of the recovery plan and actions
- File and data location and administration and backup procedure
- Review and updating frequency and process
- Review process and stakeholder input
- Process for sharing updates and reviews internally and publicly

12. Emergency planning & actions

110. Emergency planning essentially requires the following steps:

1. Understanding potential emergency situations
2. Monitor indicators and establish and early warning system
3. Set up a response plan
4. Report emergency information and share lessons learned and experiences at subregional and regional level
5. Develop prevention tactics

12.1. Marine disease outbreaks

111. Although diseases occur naturally in marine systems, they can pose a risk if caused, accelerated or spread through human activities. There are multiple factors that influence disease occurrence and spread and outcomes including pathogen dynamics, host susceptibility, and environmental factors that shape disease outcomes [15]. Yet, there are limitations relating to the detection of marine pathogens and their diagnostics, as well as in relation to active surveillance, which often comes with high costs. Currently available tools for marine disease management include [15]:

- **Biosecurity measures, habitat conservation, outbreak surveillance, and diagnostics**.
- **Response strategies** that include isolation, culling, habitat restoration, and disease modelling.
- **Prevention tactics** such as vaccination, use of natural therapeutics, and biodiversity preservation.

112. In relation to surveillance and monitoring, the literature distinguishes between the following [15,18,81,82]:

1. **Active Surveillance:** Systematic and targeted monitoring of high-risk species or areas, such as coral reef systems.
2. **Passive Surveillance:** Collection of incidental reports from fishers, researchers, and local communities.
3. **Predictive/modelling:** predictive tools like temperature-based disease forecasting to mitigate risks associated with climate change. Combines environmental data (e.g., sea surface temperature) with epidemiological information to anticipate disease outbreaks. Modelling can forecast disease-promoting conditions over timescales from days (real-time alerts) to decades (climate impact scenarios).
4. **Networks** such as Primary Responders in Marine Emergent Diseases (PRIMED) advocate for baseline monitoring and quick response protocols for marine disease emergencies and thereby enable early detection of mortality events and rapid deployment of response teams.

113. A great summary of strategies to approach, detect and handle marine disease is shown in Figure 17.

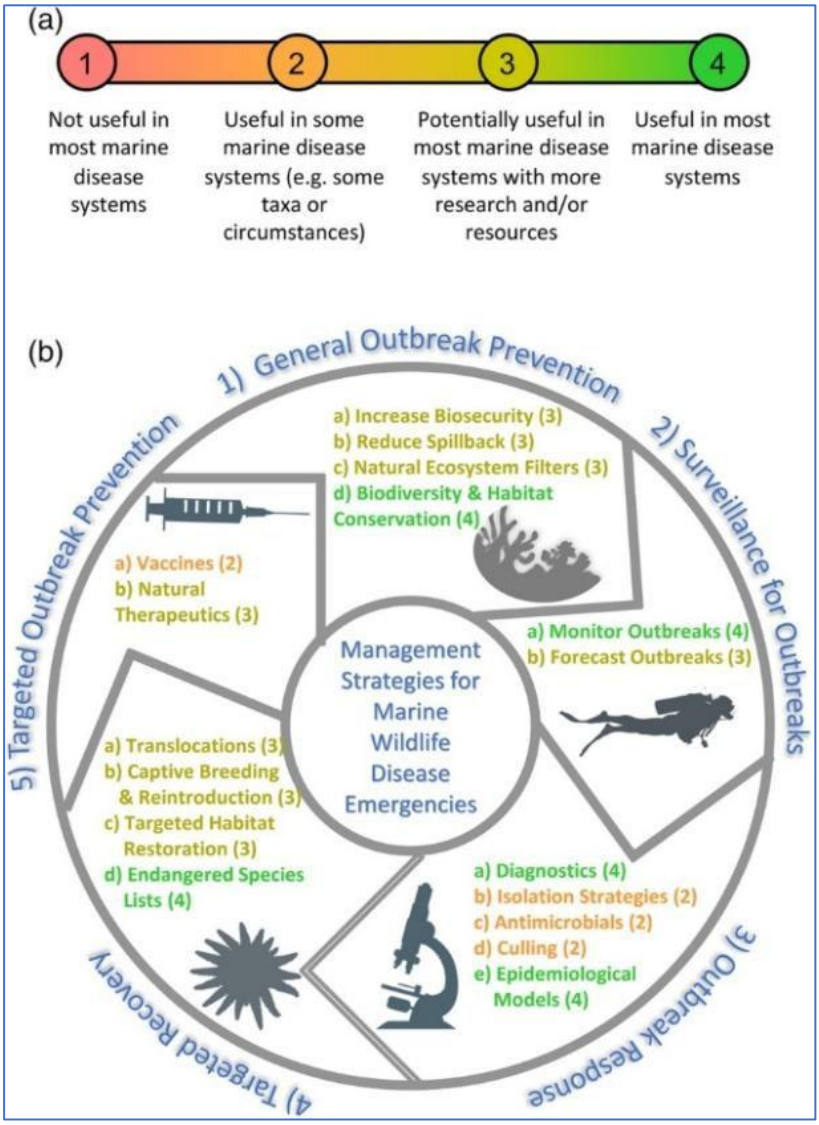

Figure 17. Marine disease strategies and their usefulness (colour indication).

114. A case study from a disastrous marine disease outbreak and some lessons learned are demonstrated in section 14.

12.2. Early warning systems

115. Early warning systems are critical for proactively managing and mitigating the impacts of marine emergencies, including 'natural' disease outbreaks, pollution events, fish farming associated diseases, and ecosystem degradation. These systems integrate monitoring, forecasting, and response frameworks to provide timely alerts and enable effective action. Systems for tracking chemical spills rely on real-time data transmission from buoys and drones, predicting pollutant dispersion and ecological impact [17,83]. Like the surveillance of marine disease outbreaks, early warning systems rely on consistent and systematic monitoring that can changes in the marine systems. Models can also support the forecasting of such regime shifts [9]. Relevant tools and parameters that are monitored, usually include a combination of the following [81–83]:

- **Physical Parameters:** Buoys equipped with sensors for sea surface temperature, salinity, and depth.
- **Biological Monitoring:** Sampling populations for pathogen presence and disease symptoms.
- **Chemical Parameters:** Monitoring pollutants like phenol and other hazardous substances.

116. Temperature-based monitoring has been effectively used for coral disease outbreaks and shellfish conditions. For example, temperature anomalies have been linked to coral bleaching and pathogen spread in marine species [81].

117. Early warning systems are pivotal in safeguarding marine ecosystems and human livelihoods against emergencies. The benefits of Early Warning Systems are various and include:

- **Timely Response:** Reduces the scale and severity of ecological damage.
- **Resource Efficiency:** Directs resources to high-risk areas, optimizing costs.
- **Enhanced Resilience:** Informs long-term management strategies and policy development.

118. However, the success of such systems depends on robust surveillance networks, predictive tools, and coordinated global actions. Enhanced integration with climate models and policy frameworks will further strengthen their role in marine conservation.

12.3. Animal strandings

119. Another form of marine emergencies with increasing research and literature are animal strandings. Strandings of marine animals have been occurring for over a century in varying locations and affecting multiple species, with less than ten percent alive when found [84]. The most prominent cases with long-standing networks are probably those of marine mammal strandings [85–87]. These events can be caused by multiple factors, including environmental changes and impacts from human activities, such as fishing and pollution [84]. Two Mediterranean countries have a stranding network in place- Spain and Croatia. The latter was set up in 2019 by the Croatian Institute for Environment and Nature Conservation as an alert network for protected species that have been captured, are dead, injured or sick [88].

13. Examples of recovery and emergency actions

120. The following four case studies provide insights into approaches to species recovery and emergency actions in a European/Mediterranean context.

Case study: Northeast Atlantic fish stocks – European hake and Atlantic mackerel

For the few Northeast Atlantic fish stocks that have experienced notably strong recoveries, such as Atlantic mackerel and European hake, the growth in stock sizes was likely initiated and supported by exceptionally strong year classes, even as fishing pressures exceeded sustainable levels. This underscores the role of favourable environmental conditions in facilitating stock recovery and promoting shifts toward higher productivity regimes. Conversely, the data suggested that declining productivity can hinder stock recovery, even when fishing pressure is reduced. Despite this, reductions in fishing effort were essential for lowering exploitation rates and enabling the recovery of spawning stocks. The observed negative correlation between fishing mortality (F) and year-to-year changes in spawning stock biomass (SSB) for most stocks highlights the significant top-down impact of fishing. These findings demonstrate that large-scale fisheries can be sustainably managed, but only if policies adopt more cautious regulations that account for periods of reduced productivity.

Source: Zimmermann, F., & Werner, K. M. (2019). Improved management is the main driver behind recovery of Northeast Atlantic fish stocks. *Frontiers in Ecology and the*

Case study: *Pinna nobilis* die-off in the Mediterranean Sea

The Mediterranean Sea serves as a valuable laboratory for studying global processes. Since September 2016, the fan mussel (*Pinna nobilis)* has suffered a mass die-off, likely caused by the protozoan *Haplosporidium pinnae*. Research indicates that the outbreak was influenced by water temperature and salinity, which are shaped by climate change and human activities. Efforts such as population surveys, rescue programs, predator protection, and larval collector installations have enhanced understanding of the factors driving the disease's spread. Between October 2016 and September 2018, researchers analysed the outbreak across Spain and neighbouring countries, documenting the spread and evaluating rescue initiatives. They recommend protecting the remaining lagoon populations by reducing activities that threaten *P. nobilis.*
The rapid and severe decline of P. nobilis—a closely monitored species—raises the question of how many less-studied marine organisms might be undergoing unnoticed die-offs, highlighting the urgency of proactive conservation measures.

Source: García-March, J. R., Tena, J., Henandis, S., Vázquez-Luis, M., López, D., Téllez, C., ... & Deudero, S. (2020). Can we save a marine species affected by a highly infective, highly lethal, waterborne disease from extinction?. *Biological Conservation*, *243*, 108498. https://doi.org/10.1016/j.biocon.2020.108498

Case study:

"News headline: **The birth of 250 red coral babies announced by the laboratories of Banyuls-sur-mer and Monaco"**

The Monaco scientific centre and the Banyuls-sur-mer oceanographic observatory work together on a program on the restoration of red coral in the mediterranean using an under-water laboratory off the coast of Banyuls. The researchers make use of an in situ set up in an area where red coral is protected to collect and study growing red corals.

Image: In situ coral culture © Banyuls-sur-mer Observatory

Image: Coral culture in the laboratory – © Guillaume Loentgen

Source: https://madeinperpignan.com/naissance-de-250-bebes-corail-rouge-laboratoires-banyuls-sur-mer-monaco/

Case study: The Recovery of Crustacean Populations in Lamlash Bay No-Take Zone, Scotland

A study examined the effects of protection on commercially valuable crustaceans within the Lamlash Bay no-take zone (NTZ), a temperate MPA. Data were collected from the NTZ and nearby control zones (near and far) using fishing surveys and passive fishing observations aboard commercial vessels during July and August 2013. Researchers recorded the abundance, size, and sex of European lobster, brown crab, and velvet crab, as well as the incidence of disease and injury in lobsters. A tag-and-release program was also conducted to monitor growth rates and movement patterns in and around the NTZ.

European lobsters responded strongly to protection, showing 33.8% higher abundance and 8.52% larger average size in the NTZ compared to the Near Control zone. Legal-sized lobsters were 118.5% more abundant in the NTZ. In contrast, crab populations were significantly less abundant within the NTZ, with the highest numbers observed in the control zones. A significant negative trend was found between lobster catch per unit effort (CPUE) and distance from the NTZ boundary, with elevated CPUE within 350 meters of the NTZ suggesting possible spillover effects.

There was no significant difference in the rates of disease or injury in lobsters between the NTZ and Near Control, indicating that the lobster population remains healthy despite increased abundance. Over the preceding year, lobster abundance in the NTZ rose by 12.34%, legal-sized lobster abundance increased by 20.86%, and mean size grew by 1.56%.

Source: **Gratton, P.2018. The Recovery of Crustacean Populations in Lamlash Bay No-Take Zone. Scotland University of York.** https://www.arrancoast.com/wp-content/uploads/2018/10/2013-Gratton-P-Recovery-of-crustaceans-in-Lamlash-NTZ-1.pdf

14. Overview of advisories and training opportunities, available data bases

121. The following sections provide some useful sources of information for species recovery and restoration planning, as well as available training opportunities and data bases.

14.1. Advisories

Society for Ecological Restoration. The Society for Ecological Restoration is an expert network available for providing guidance and practical advice. Its Europe Chapter, based in Belgium, comprises 500 scientific and practitioner members from across Europe and worldwide, including restoration research centres, non-profit organizations, and private companies. Functioning as a "network of networks," it collaborates with national restoration organizations throughout the EU.

https://chapter.ser.org/europe/about/other-regional-and-european-restoration-networks/

IUCN Expert Commissions. IUCN Commissions are extensive and dynamic networks of scientists and experts that support IUCN and its Members by offering valuable knowledge and policy guidance to advance conservation and sustainable development. More than 15,000 experts and scientists contribute their expertise as members of an IUCN Commission.

https://www.iucn.org/our-union/expertcommissions

The European Biodiversity Observation Network (EUROPABON). EuropaBON's mission is to address existing data gaps and workflow challenges by developing an EU-wide framework for monitoring biodiversity and ecosystem services. It aims to integrate data streams to effectively support policy-making.

https://europabon.org/members/home

14.2. Training

SER developed a free e-learning course to introduce practitioners and professionals to the core components of restoration and how to implement the Standards on the ground. This course is currently being adapted to reflect updates from the second edition of the Standards.
https://www.ser.org/page/elearningcourse

The **IUCN Conservation Planning Specialist Group** offers training for practitioners to develop single and multi-species recovery plans and hold relevant stakeholder workshops. https://www.cpsg.org/our-work/capacity-building/courses/facilitating-species-conservation-planning-workshops

14.3. Databases and relevant projects

European Commission. LIFE Public Database. The LIFE Public Database offers an overview and detailed descriptions of completed and ongoing projects. These projects frequently include insights into the planning process, objectives, restoration methods, and future steps, serving as exemplary case studies for planning future restoration and conservation initiatives.

https://webgate.ec.europa.eu/life/publicWebsite/search

Deep Reef restoration and litter removal in the Mediterranean Sea (2022-2027) project. The website provides a comprehensive overview of the restoration measures. Active restoration, such as deploying artificial structures as substrates to promote the growth of deep reef-forming species, will be combined with passive restoration efforts, including the removal of marine litter from deep reef areas. Engaging fishers and stakeholders in LIFE DREAM activities aims to amplify the project's impact and foster social behaviour

change. The outcomes of LIFE DREAM are expected to serve as a foundation for expanding the Natura 2000 network into the deep Mediterranean Sea and restoring sensitive deep habitats by offering best practices for deep reef restoration, along with insights into the associated costs and benefits.

https://webgate.ec.europa.eu/life/publicWebsite/project/LIFE21-NAT-IT-LIFE-DREAM-101074547/deep-reef-restoration-and-litter-removalin-the-mediterranean-sea

BIOcean5D (2022-2026) project. Marine Biodiversity Assessment and Prediction Across Spatial, Temporal and Human Scales. BIOcean5D brings together leading European institutions in molecular and cell biology (EMBL), marine biology (EMBRC), and sequencing (Genoscope), alongside 26 partners from 11 countries, to develop an innovative suite of technologies, protocols, and models. This initiative enables a comprehensive re-exploration of marine biodiversity—from viruses to mammals and genomes to holobionts—spanning multiple spatial and temporal scales, from pre-industrial times to the present. A key focus is to study pan-European biodiversity gradients from land to sea and ecosystem services, including marine exposomes. Central to this effort is a regional expedition (2023/24), which will utilize mobile labs, research vessels and cutting-edge citizen science tools across 21 coastal countries and 35 marine labs, from the Mediterranean to the Arctic. The resulting new data will be harmonized with existing datasets in an open-access data hub, leveraging international infrastructures to produce transformative, standardized marine biodiversity knowledge across technologies, scales, and socio-ecosystem levels.

https://cordis.europa.eu/project/id/101059915

EFFECTIVE (2023-2027) project. Enhancing social well-being and economic prosperity by reinforcing the effectiveness of protection and restoration management in Mediterranean MPAs. The primary objective of the EFFECTIVE project is to establish a robust scientific knowledge base and provide practical guidance by integrating science, technological nature-based solutions, digitalization, and social considerations. This approach supports the application of Ecosystem-Based Management (EBM) to the protection and restoration of the EU's Mediterranean Blue Natural Capital. To achieve this goal, EFFECTIVE brings together partners with extensive expertise across all three pillars of EBM—managerial, informational, and participatory—along with a focus on nature-based solutions. Additionally, the project implements EBM strategies in four pilot areas (Mar de l'Empordà, Ebro Delta, Northern Sardinia, and Cavo Greco) to develop effective protection and restoration solutions.

https://cordis.europa.eu/project/id/101112752

15. Recommendations for actions and next steps

122. Considering the Mediterranean context and best practices for species recovery planning and emergency actions, the following table identifies next steps and recommended actions by different key players in the region, as demonstrated in Table 2.

Table 2. Recommended steps and actions to progress species recovery plans in the Mediterranean region.

Context	Action	Timeframe	Responsibility
Research	Develop a protocol for uniform data collection for species recovery purposes and sharing across jurisdictions.	As soon as possible	SPA/RAC, GFCM, Partners, Contracting Parties
Capacity building	Provide training national practitioners in recovery planning.	As soon as possible	SPA/RAC, Partners
Research	Increase research in marine disease and its linkage to climate change.	As soon as possible and continuous	SPA/RAC, Partners, Contracting Parties
Research	Prioritisation of species for recovery actions at national level and identification of relevant areas.	As soon as possible and continuous	Contracting Parties
Capacity building	Hold workshops to exchange lessons learned from species recovery actions regionally.	As soon as possible and regularly thereafter	SPA/RAC, GFCM, Partners, Contracting Parties
Stakeholder engagement	Stakeholder evaluation and engagement to understand species values and recovery priorities	As soon as possible and regularly thereafter	Contracting Parties
Emergency planning	Define a list of indicators and thresholds for marine emergencies and develop early-response plans.	As soon as possible and regularly thereafter	SPA/RAC, Contracting Parties
Recovery planning	Assess national administration systems for permitting and licensing conditions to enable and support both passive and active restoration activities.	As soon as possible and regularly thereafter	Contracting parties
Research & evaluation	Assess data poor threatened species and increase coordinated research efforts defining specific questions related to species recovery.	As soon as possible and regularly thereafter	SPA/RAC, GFCM, Partners, Contracting Parties
Research & evaluation	Create a threat data base for Annex II and III species.	As soon as possible and updated regularly thereafter	SPA/RAC, GFCM, Partners, Contracting Parties
Research	Develop regional recovery criteria.	1-2 years	SPA/RAC, GFCM, Partners, Contracting Parties
Public Awareness and Training- Early warning systems	Educate stakeholders, including local communities, fishers and aquaculture operators, to identify early warning signs and report them promptly.	1-2 years	Contracting Parties, GFCM

Cooperation	Strengthen cooperation and coordination of recovery actions for fish stocks and species affected by fishing with GFCM	1-2 years	SPA/RAC, GFCM, Partners, Contracting Parties
Recovery prioritisation	Identify species for which regional or subregional cooperation is needed in recovery.	1-2 years	SPA/RAC, GFCM, Partners, Contracting Parties
Cooperation	Develop a platform to share national recovery plans	2-3 years	SPA/RAC
Coordination	Share lessons learned from stranding networks and coordinate regional approach to further establish wider networks.	2-3 years	SPA/RAC, Partners, Contracting Parties
Financing	Introduce clear regulatory frameworks and financial incentives to attract private investment	2-3 years	Contracting Parties
Financing	Develop mechanisms to ensure availability of early-stage funding, such as venture philanthropy or impact investment.	2-3 years	SPA/RAC, Partners, Contracting Parties
Recovery actions	Encourage projects that not only restore ecosystems but also provide measurable benefits, such as carbon credits, biodiversity gains, or sustainable resource use.	2-3 years	SPA/RAC, Contracting Parties
Cooperation	Start to build partnerships for species recovery actions.	2-3 years	SPA/RAC, GFCM, Partners, Contracting Parties
Early warning systems	Foster international cooperation in surveillance and response of marine emergencies and create early warning systems.	2-3 years	SPA/RAC, Contracting Parties
Stakeholder engagement	Engage local stakeholders to align restoration goals with community and economic interests.	3-4 years	Contracting Parties
Emergency planning	Strengthen policy frameworks to include disease mitigation as a priority.	3-4 years	SPA/RAC, Contracting Parties
Emergency planning	Promote ecosystem health and establish disease-specific contingency plans.	3-4 years	Contracting Parties
Recovery approaches	Evaluation of recovery approaches for species – shared lessons learned	3-4 years	SPA/RAC, Contracting Parties

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17. ANNEXES

Table 3. Examples of recovery plans (different levels) including type of plan, year, species, country and a brief summary outline.

Recovery plan	Type	Species/Habitat	Year	Country	Summary	Reference
Recovery Plan for the Queen Conch (Strombus gigas)	Single species	Queen Conch	2009	Bermuda	Recovery plan that considers habitat protection, active breeding, and optimal self-recruitment to ensure population recovery and sustainability.	Sarkis, S. and J. Ward. 2009. Recovery Plan for the Queen Conch (*Strombus gigas*), in Bermuda. Department of Conservation Services, Government of Bermuda. 38 pages
Sea Turtle Recovery Action Plan for the Republic of Trinidad and Tobago	Multiple species	Loggerhead Sea (*Caretta caretta*) Turtle; Green Sea Turtle (*Chelonia mydas*); Leatherback Sea Turtle (*Dermochelys coriacea*); Hawksbill Sea Turtle (*Eretmochelys imbricata*); Kemp‟s Ridley Sea Turtle (*Lepidochelys kempii*); Olive Ridley Sea Turtle (*Lepidochelys olivacea*)	2010	Trinidad and Tobago	Developed with the assistance of UNEP, this recovery plan covers a detailed threat analysis and respective actions across life stages with the support of local communities and wider stakeholders.	Forestry Division (Government of the Republic of Trinidad and Tobago), Save our Seaturtles-Tobago, and Nature Seekers. 2010. WIDECAST Sea Turtle Recovery Action Plan for Trinidad & Tobago (Karen L. Eckert, Editor). CEP Technical Report No. 49. UNEP Caribbean Environment Programme. Kingston, Jamaica. xx + 132 pages.
A recovery/ conservation programme for marine species of conservation importance	Multiple species	A large list of species	2011	United Kingdom	This report identifies conservation priorities and score species by recovery potential.	HISCOCK, K., BAYLEY, D., PADE, N., COX, E. & LACEY, C. 2011. A recovery / conservation programme for marine species of conservation importance. Natural England Commissioned Reports, Number 065.
Sawfish and River Sharks Multispecies Recovery Plan	Multiple species	Largetooth sawfish (*Pristis pristis*); Green sawfish (*Pristis zijsron*); Dwarf sawfish (*Pristis clavata*); Speartooth shark (*Glyphis glyphis*); Northern River shark (*Glyphis garricki*)	2015	Australia	This recovery plan outlines the research and management actions needed to halt the decline and promote the recovery of five species in Australian waters. The primary aim of the plan is to support the recovery of these species in their natural habitats across their range in Australian waters by increasing their overall population size. The plan is divided in two parts with an accompanying issues paper, which provides detailed background information on the species' biology, population status, and the threats they face.	‘Sawfish and River Sharks Multispecies Recovery Plan, Commonwealth of Australia 2015’.

Final Coastal Multispecies Recovery Plan for California Coastal Chinook Salmon, Northern California Steelhead and Central California Coast Steelhead	Multiple species	Coastal Chinook Salmon, Northern California Steelhead and Central California Coast Steelhead	2016	United States of America	Very detailed plan considering both species needs and recovery actions and socio-economic implications	National Marine Fisheries Service. 2016. Coastal Multispecies Recovery Plan. National Marine Fisheries Service, West Coast Region, Santa Rosa, California
Recovery Plan for Marine Turtles in Australia	Multiple species	Green turtle (*Chelonia mydas*); Loggerhead turtle (*Caretta caretta*); Hawksbill turtle (*Eretmochelys imbricata*); Flatback turtle (*Natator depressus*); Olive ridley turtle (*Lepidochelys olivacea*); Leatherback turtle (*Dermochelys coriacea*)	2017	Australia	Comprehensive and well-designed recovery plan considering multiple species and their life stage requirements for recovery. It defines and assigns responsibilities amongst different partners in the process.	Recovery Plan for Marine Turtles in Australia, Commonwealth of Australia 2017.
Native Fish Recovery Plan. Gunbower and lower Loddon	Habitat and species	Habitat - network of creeks, lagoons, wetlands and floodplains	2019	United States of America	Recovery plan that considers habitat rehabilitation and recovery and re-introduction of native species.	North Central Catchment Management Authority. 2019. Native Fish Recovery Plan. Gunbower and lower Loddon.
North Devon Marine Nature Recovery Plan 2022-2027	Habitat and species	A large list of species	2021	United Kingdom	Detailed plan that has a section ofr each habitat type and (associated) species and identifies clear barrier identification and policy alignment options.	North Devon Marine Nature Recovery Plan 2022-2027. Produced for North Devon Biosphere through the Environment Agency's Championing Coastal Coordination funding initiative and delivered by Rose Stainthorp, Beccy MacDonald-Lofts and Kovia.
Draft Recovery Plan for the Giant Manta Ray (*Mobula birostris*)	Single species	Giant manta ray	2024	United States of America	The recovery plan covers the entire geographic range of this migratory species with a regional threat analysis and actions that require international cooperation.	National Marine Fisheries Service. 2024. Draft Recovery Plan for the Giant Manta Ray (*Mobula birostris*). October 2024, Version 1. NOAA Fisheries, Office of Protected Resources, Silver Spring, MD. 20901. 59 pages.
National Recovery Plan for the Southern Right Whale	Single species	Southern Right Whale	2024	Australia	A very well-designed and detailed recovery plan that analysis and prioritises threats and tackles them systematically.	Department of Climate Change, Energy, the Environment and Water (DCCEEW).2024. National Recovery Plan for the Southern Right Whale, Department of Climate Change, Energy, the

					Environment and Water, Canberra

Table 4. Available guidance for ecosystem restoration and species recovery planning.

Name	Year	Lead organisation/author	Focus	Purpose
Standards of Practice to Guide Ecosystem Restoration	2024	FAO, SER and IUCN-CEM (Nelson, C.R., Hallett, J.G., Romero Montoya, A.E. et al.)	All ecosystems	Offers recommendations applicable to the entire restoration process across all sectors of society, diverse land and sea uses, ecosystems, regions, and various ecosystem restoration activities.
Standards of Practice to Guide Ecosystem Restoration. A contribution to the United Nations Decade on Ecosystem Restoration 2021–2030	2024	Nelson et al.	All ecosystems	Guidance in restoration in the context of the UN Decade with details on crucial components of restoration planning
Guidance and Recommendations for Ambitious Nature Restoration Plans	2024	WWF	All ecosystems	explains obligations and opportunities for the implementation of the newly adopted EU Nature Restoration Law
Rebuilding nature. Good practice guidance for ecological restoration	2023	Hicks, J. Chartered Institute of Ecology and Environmental Management, Romsey.	All ecosystems	Sets out ten good practice principles for ecological restoration projects in the terrestrial, freshwater and marine environments of the UK and Ireland
International Principles and Standards for the Practice of Ecological Restoration (2nd ed.)	2019	SER (Gann, G.,McDonald, T., Walder, B., et al.)	All ecosystems	Provides a framework to guide restoration projects in achieving their goals, addressing challenges, and managing trade-offs related to land management priorities and decisions. The framework is built upon eight fundamental principles that support ecological restoration.
NMFS Recovery Planning Handbook	2020	U.S Department of Commerce National Oceanic and Atmospheric Administration	All species	A very detailed guidance document for the development of species recovery plans with case studies to demonstrate and illustrate experience and best practices
Delivering Restoration Outcomes for Biodiversity and Human Well-Being. Resource guide to Target 2 of the Kunming-Montreal Global Biodiversity Framework (2024)	2024	FAO, SCBD & SER	All species and habitats	helps to integrate the human dimension into restoration planning and aligns it with the obligations under the global biodiversity framework
Guidance and tools for effective restoration measures for species and habitats	2021	Chapter B.I: Decleer, K. & Bijlsma, R.	Species and habitats	presents a tool - the recovery wheel – for conveying progress of recovery over time and a 1–5-star recovery scale interpreted in the context of the six key ecosystem attributes used to measure progress along a trajectory of recovery
Nature Recovery Network Handbook	2020	The Wildlife Trusts	European habitats and species	follows a spatial approach to recovery planning and prioritisation of efforts
Coral Reef Restoration as a Strategy to Improve Ecosystem Services	2020	UNEP (Hein MY, McLeod, I.M., Shaver, E.C, et al.)	Coral reefs	Gives an overview of best-available science and advice on how to design a management strategy for reef restoration
Training Guide for Coral Reef Restoration	2020	Mesoamerican Reef System (Mar Fund) Reef Rescue Initiative	Coral Reefs	is a practical tool for specialists, students, technicians, trainers, and the general audience, who are interested in implementing techniques for coral reef restoration
Reef Rehabilitation Manual	2010	CRTR (Edwards, A.J. (ed)).	Coral Reefs	Considering costs and approaching coral reef restoration by learning from experience

Reef Restoration: Concepts and Guidelines	2007	CRTR (Edwards and Gomez)	Coral Reefs	Advice designed for coastal managers, decision-makers, technical experts for community-based reef restoration
Essential guide to successful recovery plans for Europe's fish stocks	2006	WWF	European fish stocks	A six-step guide for conducting fish stock recovery
Best Practice Guidelines for Mangrove Restoration	2023	Global Mangrove Alliance (Howard, J.,Lovelock, C., Beeston,M. et al.)	Mangroves	A step-by-step approach for mangrove restoration
Setting objectives for oyster habitat restoration using ecosystem services: A manager's guide	2016	TNC (zu Ermgassen, P., Hancock, B.,DeAngelis, B., et al.)	Oyster reefs - Global	Consider oyster reef restoration from a resource management perspective
European Native Oyster Habitat Restoration Monitoring Handbook	2021	Native Oyster Restoration Alliance (NORA) Europe (zu Ermgassen, P.S.E., Bos,O., Debney, A., et al. (eds.))	Oyster reefs in Europe	Overview of minimum monitoring requirements and optional monitoring
European Native Oyster Habitat Restoration Handbook	2020	Native Oyster Restoration Alliance (NORA) Europe. Preston J., Gamble, C.,Debney, A., et al. (eds.)	Oyster reefs in Europe	Gives insights into European efforts for oyster reef restoration
European Guidelines on Biosecurity in Native Oyster Restoration	2020	Native Oyster Restoration Alliance (NORA) Europe. zu Ermgassen, P.S.E., Gamble, C., Debney, A., Colsoul, B., et al., (eds.)	Oyster reefs in Europe	Supports considerations on biosecurity in a European context
Ecological Restoration for Protected Areas. Principles, Guidelines and Best Practices.	2012	IUCN (Keenleyside, K., Dudley, N., Cairns, S., et al.)	Protected areas	Offers guidance for managers of terrestrial, marine, and freshwater protected areas at both system-wide and site-specific levels on restoring the natural and associated values of these areas. It outlines principles, shares best practices, and includes case studies to support effective restoration efforts.
Guidelines for the Active Restoration of *Posidonia oceanica*	2024	Pergent-Martini et al.	Sea grass	Step-by-step guidance document for recovery of *P. oceanica,* a key habitat of the Mediterranean Sea.
Restoration Guidelines for Shellfish Reefs	2019	SER and TNC (Fitzsimons, J.,Branigan, S., Brumbaughg, R.D., et al.)	Shellfish reefs	Provides decision-making advice for shellfish restoration by providing examples and novel techniques
Principles and Guidelines for Wetland Restoration	2002	Ramsar	Wetlands	Guidelines for successfully delivering wetland restoration