Ecologic Institute

Science and Policy
for a Sustainable World

Exploring the potential of Nature-Based Solutions in marine and coastal ecosystem recovery and resilience

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Lecture for the:

47TH UNEP/UNESCO/BMUV INTERNATIONAL POSTGRADUATE COURSE ON ENVIRONMENTAL MANAGEMENT FOR DEVELOPING COUNTRIES (EM47)

May 2024, Vilm

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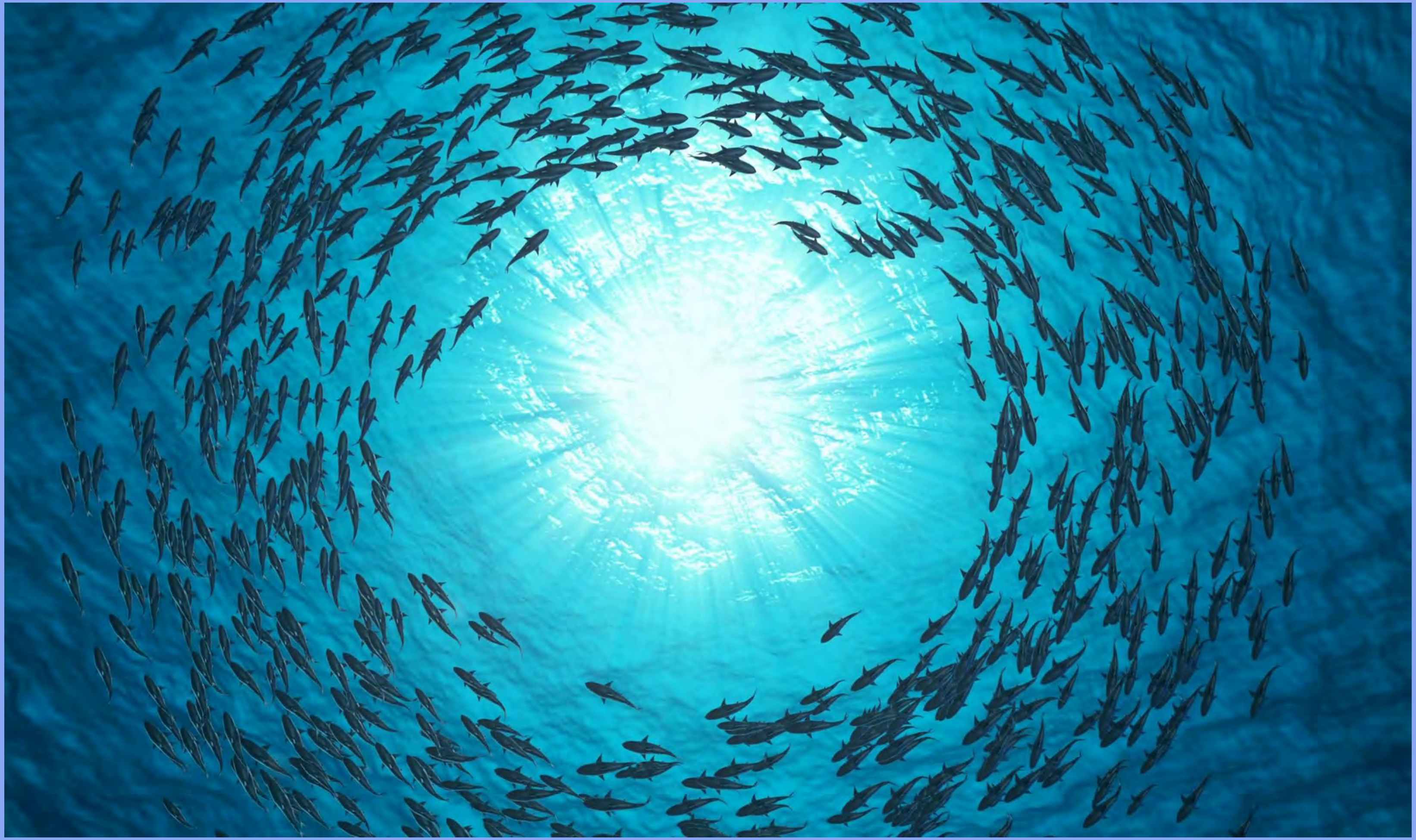
Welcome :)



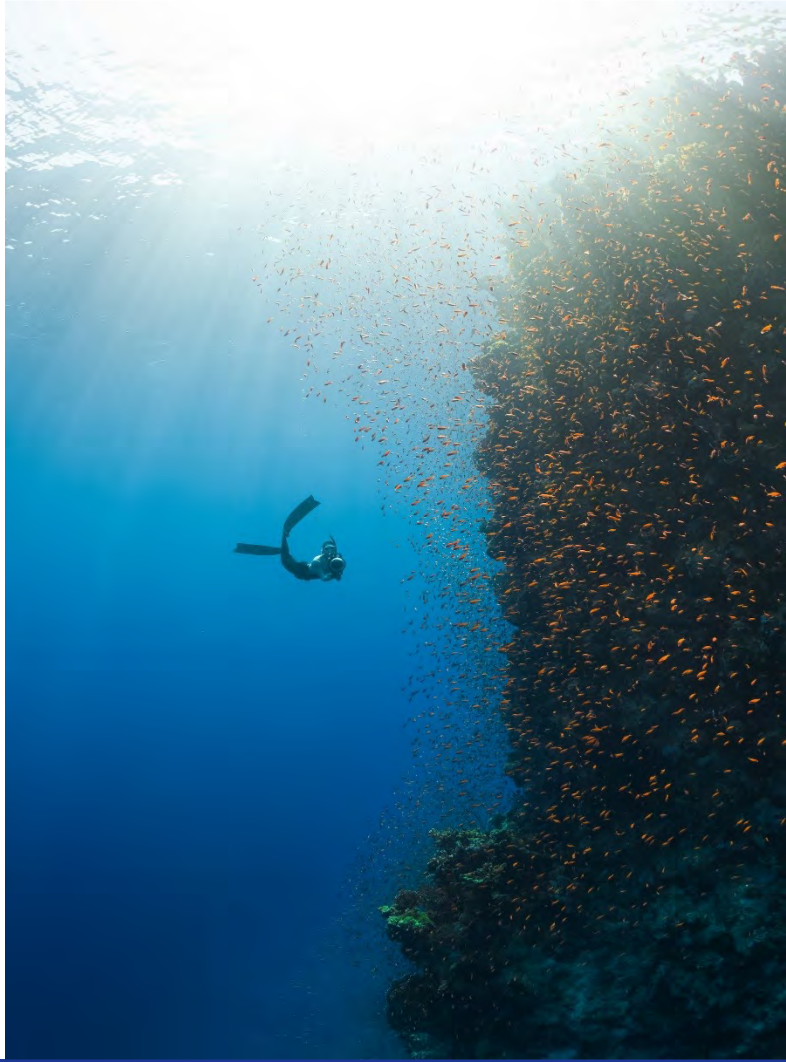
Block I: Background and context

Background and context

Part I Ocean's role and threats to marine biodiversity

The ocean: life-support system & climate regulator

- Spanning **71%** of the planet, marine and coastal ecosystems provide manifold **ecosystem services** essential to human well-being, including oxygen production, food and water supply, climate mitigation and adaptation, and host to **80% of global biodiversity**.
- **40%** of the global population resides within 100 km of the coast, steadily rising. Over **3 billion people**, primarily in developing nations, rely on marine and coastal biodiversity for their **livelihoods.** For **1 billion people**, food from the ocean is their primary source of protein.
- **Economic benefits** including jobs and finance in sectors such as fisheries, renewable energy, eco-friendly tourism, etc.

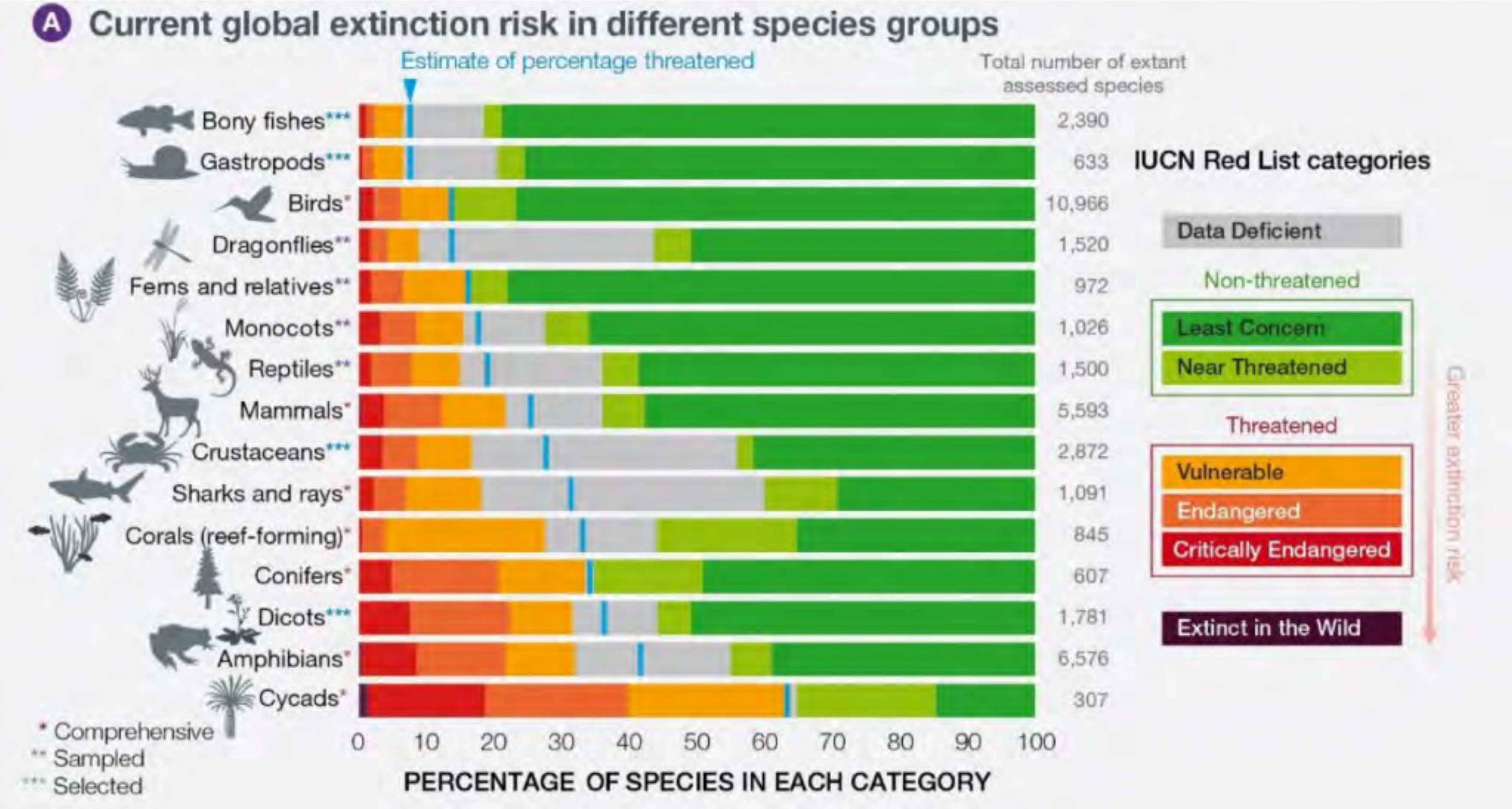


CBD, 2016; UN, 2017; Lovelock & Duarte, 2019; Menéndez et al., 2020; Image: Unsplash

The Biosphere provides life support systems upon which prosperity and development ultimately rest

Source: Stockholm Resilience Centre

Global biodiversity at risk



Key drivers of marine biodiversity loss

Overexploitation: Over 1/3 of commercial fish species are severely depleted due to unsustainable fishing practices and bycatch, placing thousands of marine species at risk of extinction.

Habitat Destruction & Changes in Sea Use: Unregulated coastal development and harmful practices are causing extensive loss and degradation of critical habitats.

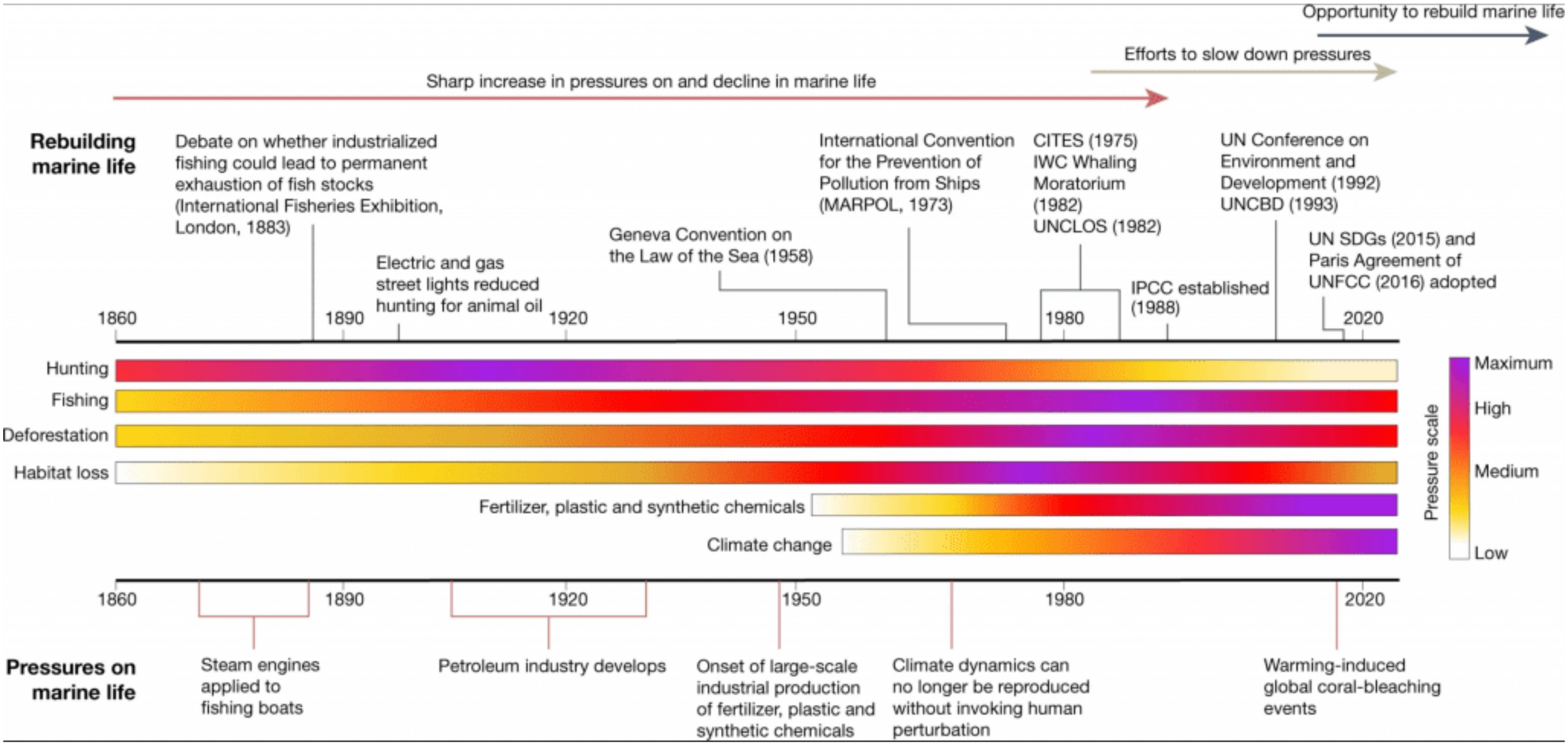
Climate Change & Ocean Acidification: Rising CO2 levels have led to increased ocean temperatures, acidity and amplified oxygen depletion, critically threatening marine organisms, particularly corals and shellfish.

Pollution: Marine ecosystems are compromised by pollutants like (micro)plastics, heavy metals, and excess nutrients, causing eutrophication, harming marine life, and disrupting the food chain.

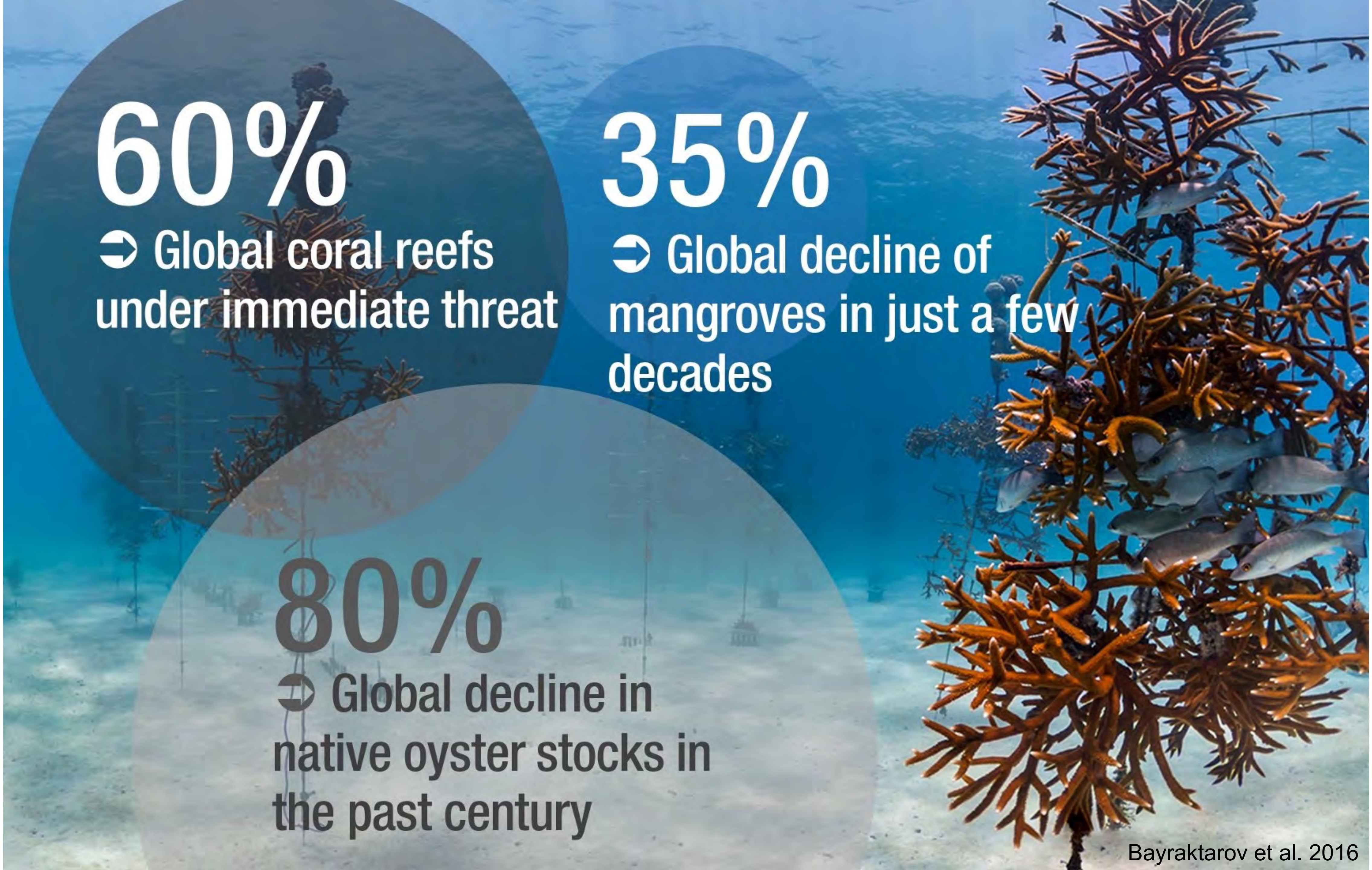
Invasive Species: Influx of non-native species disrupts ecosystem equilibrium, leading to the decline or extinction of native species and habitat transformation.

Images: Unsplash

IPBES 2019; IPCC, 2019; FAO, 2022



Duarte et al. 2020

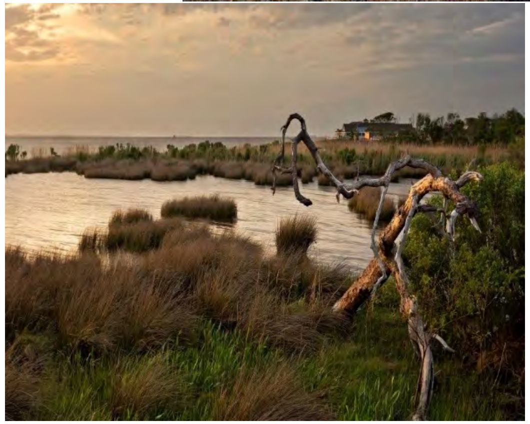

60%
➲ Global coral reefs under immediate threat
35%
➲ Global decline of mangroves in just a few decades
80%
➲ Global decline in native oyster stocks in the past century
Bayraktarov et al. 2016

State of EU seas

- 93 % of Europe’s marine area is under different pressures from human activities (fishing, tourism, marine traffic, coastal development, etc.) and there is hardly any part of this area that is not affected by at least two pressures
- Particularly intensive use exists in Europe’s coastal and transitional waters
- 43% of Europe's shelf/slope seabed is under physical disturbance (35% caused by bottom trawling), increasing to 79% when focusing on the coastal strip (0-10km)
- 40% of EU fish stocks are subject to overfishing with catch quotas having been repeatedly set above scientifically recommended levels

For references, see Fuchs & Stelljes (2022)

Example: Saltmarshes



- **Loss:** 50% of salt marshes worldwide have been either degraded or lost due to human activities
- **Services:** coastal protection, water purification, carbon sequestration, raw materials & food, maintenance of fisheries, biodiverse habitat, tourism, recreation, education & research

Table 2 | Carbon burial and soil stocks in vegetated coastal ecosystems.

Ecosystem	Local C burial rate (g C m^{-2} yr^{-1})	Local C stock in soil (Mg C ha^{-1})	Global C burial rate (Tg C yr^{-1})	Global C stock in soil (Pg C)
Salt marshes	218±24[5]	162 (259)[65]	4.8-87.3[5]	0.4-6.5
Mangroves	163[35]	255[64] (683.4)[38]	22.5-24.9[35]	9.4-10.4
Seagrasses	138±38[5]	139.7 (372)[39]	48.0-112[5]	4.2-8.4[39]

Mean and, when available, standard error of the mean (±s.e.m.) of organic carbon (C) burial and stock within the top 1 m of soil. Maximum local C stock is provided in brackets. Global C stocks are estimated from local C stocks and ecosystem extension (Table 1) unless indicated. Superscript numbers indicate the reference sources of data.

”

The conservation and protection of ecosystems that act as carbon sinks are among the cheapest, safest and easiest solutions to reduce greenhouse gas emissions and promote adaptation to climate change.”

Jones et al., 2012

- **BLUE CARBON ECOSYSTEMS**

Degradation

Examples of healthy (rich ecosystem services; e.g., food supply, nursery grounds, coastal protection)

versus

Degraded (poor ecosystem services) marine ecosystem sites

Abelson et al. 2015

Background and context

Part II Introduction to marine nature-based solutions

“Conserving nature and adapting to climate change are two sides of the same coin”

Inger Andersen,
Executive Director of the United Nations Environment Programme

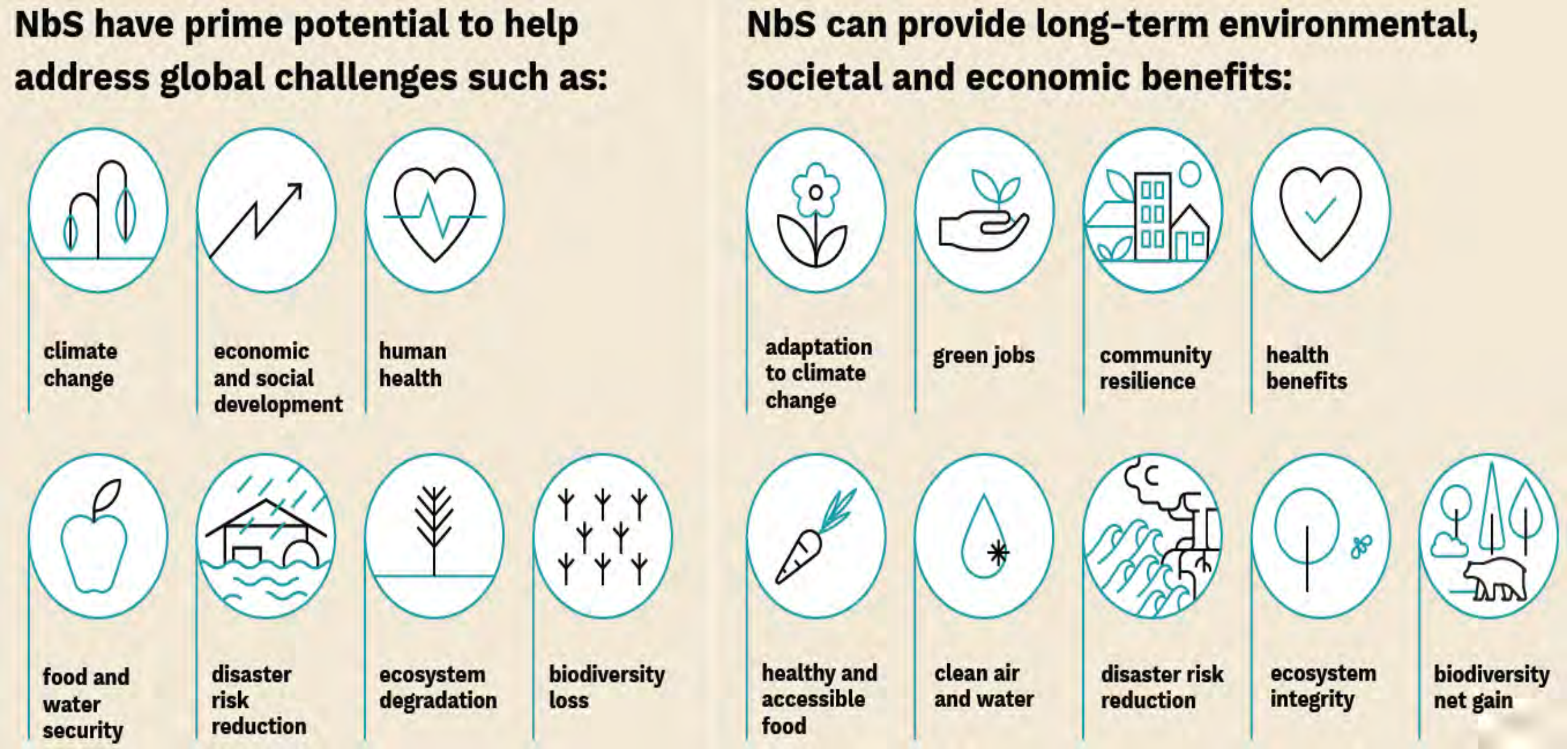
Image: IPBES & IPCC

Understanding of NBS

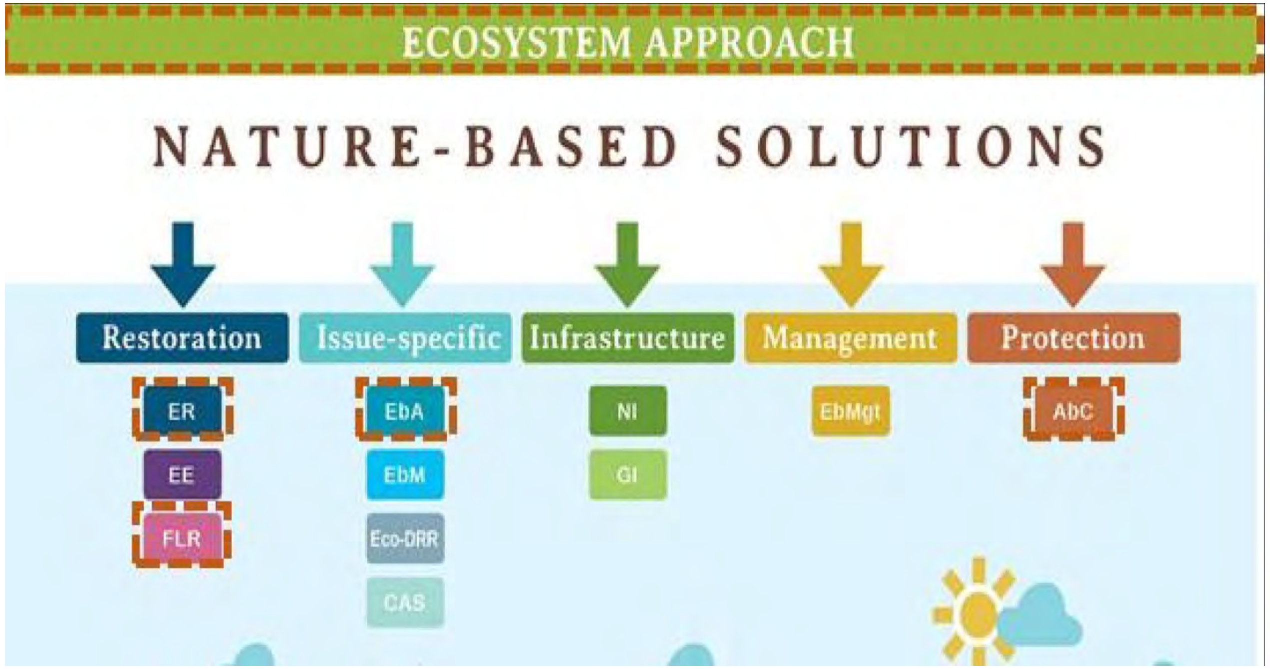
Understanding of NBS

- Inspired by, supported by or copied from nature
- Maintaining/enhancing natural capital as basis

- Cost-effective, resource- and energy-sufficient and resilient to change
- Fostering citizens well-being and human health and providing business opportunities



Timeline of the publications relevant for the NBS concept

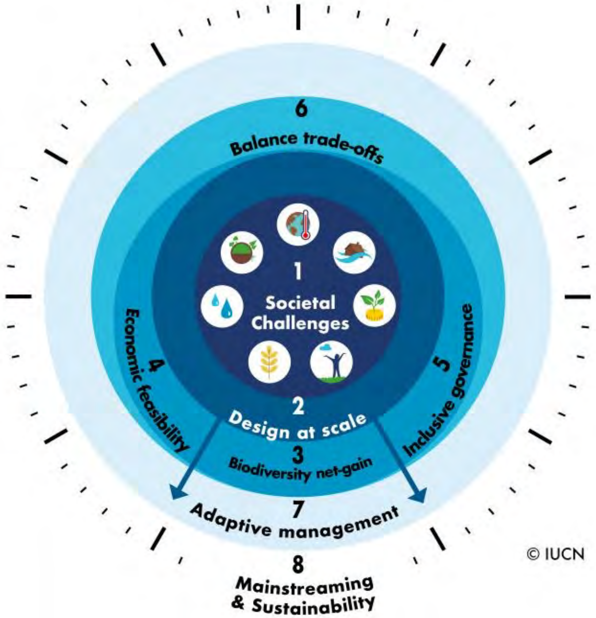


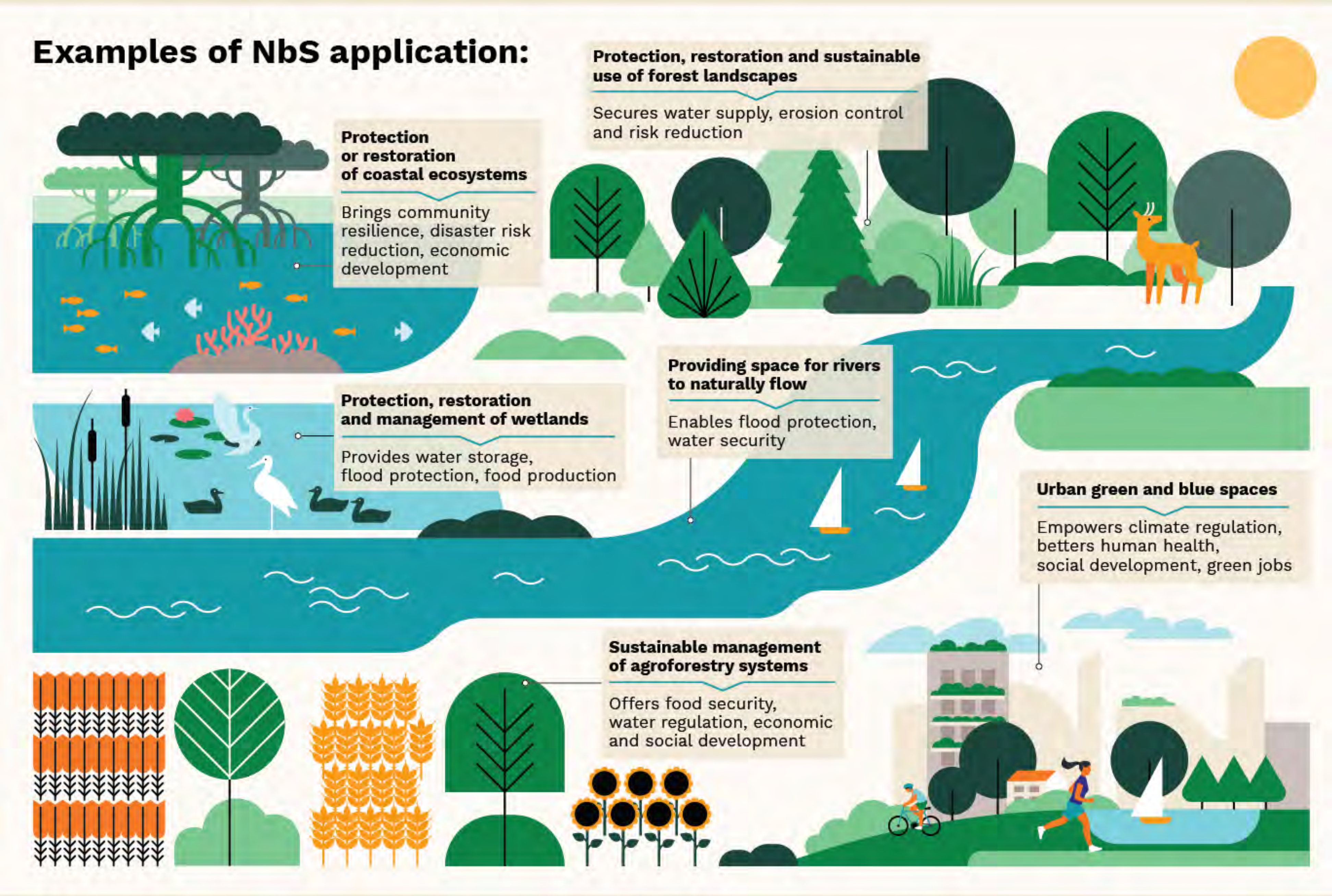
NbS concepts

- **ER** Ecological Restoration
- **EE** Ecological Engineering
- **FLR** Forest Landscape Restoration
- **GI** Green Infrastructure
- **NI** Natural Infrastructure
- **EbMgt** Ecosystem-based Management
- **EbA** Ecosystem-based Adaptation
- **EbM** Ecosystem-based Mitigation
- **Eco-DRR** Ecosystem-based Disaster Risk Reduction
- **CAS** Climate Adaptation Services
- **AbC** Area-based Conservation

Table 4. Categories and examples of NbS approaches

Category of NbS approaches	Examples
Ecosystem restoration approaches	Ecological restoration Ecological engineering Forest landscape restoration
Issue-specific ecosystem-related approaches	Ecosystem-based adaptation Ecosystem-based mitigation Climate adaptation services Ecosystem-based disaster risk reduction
Infrastructure-related approaches	Natural infrastructure Green infrastructure
Ecosystem-based management approaches	Integrated coastal zone management Integrated water resources management
Ecosystem protection approaches	Area-based conservation approaches including protected area management





Examples of NbS application:
Protection or restoration of coastal ecosystems
Brings community resilience, disaster risk reduction, economic development
Protection, restoration and sustainable use of forest landscapes
Secures water supply, erosion control and risk reduction
Protection, restoration and management of wetlands
Provides water storage, flood protection, food production
Providing space for rivers to naturally flow
Enables flood protection, water security
Urban green and blue spaces
Empowers climate regulation, betters human health, social development, green jobs
Sustainable management of agroforestry systems
Offers food security, water regulation, economic and social development

- Nature-based solutions in **coastal and marine ecosystems** are actions to protect, sustainably manage and restore these ecosystems in ways that address societal challenges effectively and adaptively.
- Ability of coastal and marine ecosystems to sequester CO2 (i.e., blue carbon ecosystems),
- Ability to foster adaptation and resilience of communities and ecosystems, by acting as buffers against climate change impacts while improving livelihoods.

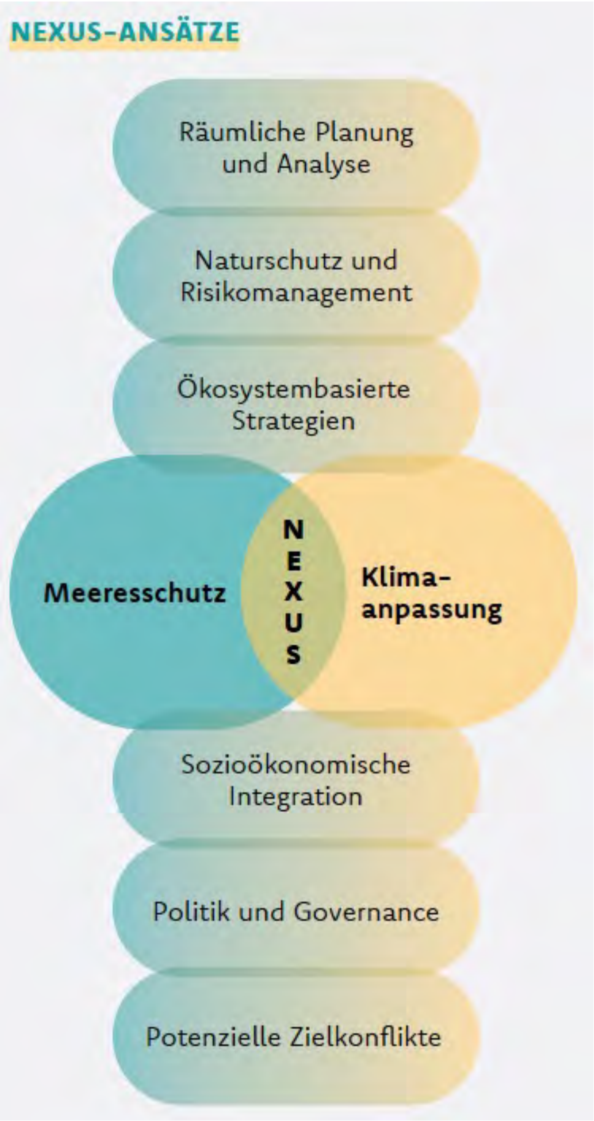
The Ocean and Climate Platform, 2021

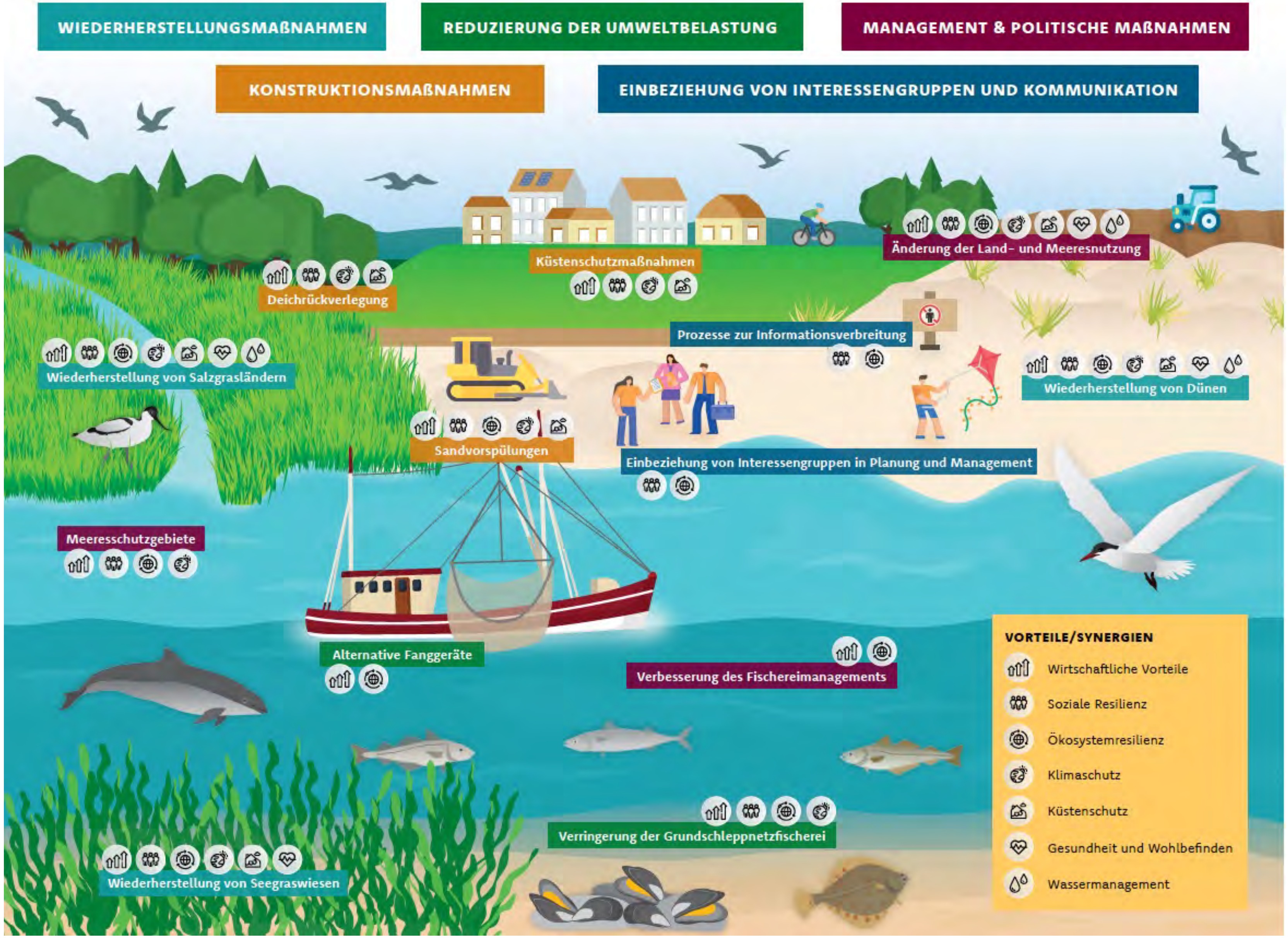
Image © Unsplash

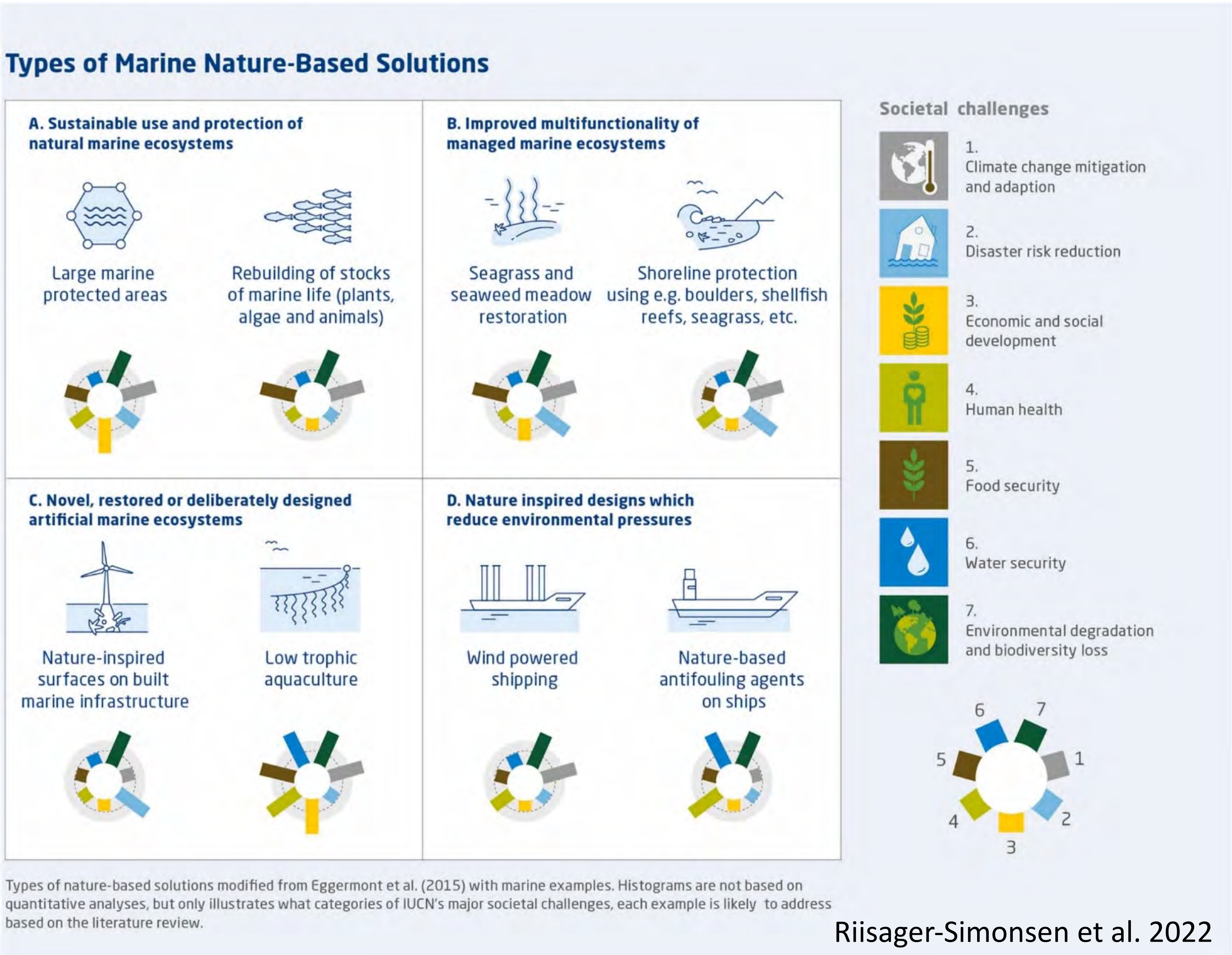
https://ocean-climate.org/en/home-4/

- Restoration of coastal marine systems can be used as a nature-based solution to improve biodiversity and support human health and wellbeing.
- Restoring marine areas can enable marine and coastal ecosystems to (once again) perform their natural functions, improving their overall health and resilience.
- It also can significantly increase the sustainable supply of marine ecosystem services on which we depend including the reduction of climate risk and improving coastal adaptation.

Sauners et al. 2020


NEXUS-ANSÄTZE
Räumliche Planung und Analyse
Naturschutz und Risikomanagement
Ökosystembasierte Strategien
Meeresschutz
NEXUS
Klima-anpassung
Sozioökonomische Integration
Politik und Governance
Potenzielle Zielkonflikte


WIEDERHERSTELLUNGSMAßNAHMEN
REDUZIERUNG DER UMWELTBELASTUNG
MANAGEMENT & POLITISCHE MAßNAHMEN
KONSTRUKTIONSMAßNAHMEN
EINBEZIEHUNG VON INTERESSENGRUPPEN UND KOMMUNIKATION
Küstenschutzmaßnahmen
Änderung der Land- und Meeresnutzung
Deichrückverlegung
Prozesse zur Informationsverbreitung
Wiederherstellung von Salzgrasländern
Wiederherstellung von Dünen
Sandvorspülungen
Einbeziehung von Interessengruppen in Planung und Management
Meeresschutzgebiete
Alternative Fanggeräte
Verbesserung des Fischereimanagements
Verringerung der Grundschleppnetzfischerei
Wiederherstellung von Seegraswiesen
VORTEILE/SYNERGIEN
Wirtschaftliche Vorteile
Soziale Resilienz
Ökosystemresilienz
Klimaschutz
Küstenschutz
Gesundheit und Wohlbefinden
Wassermanagement



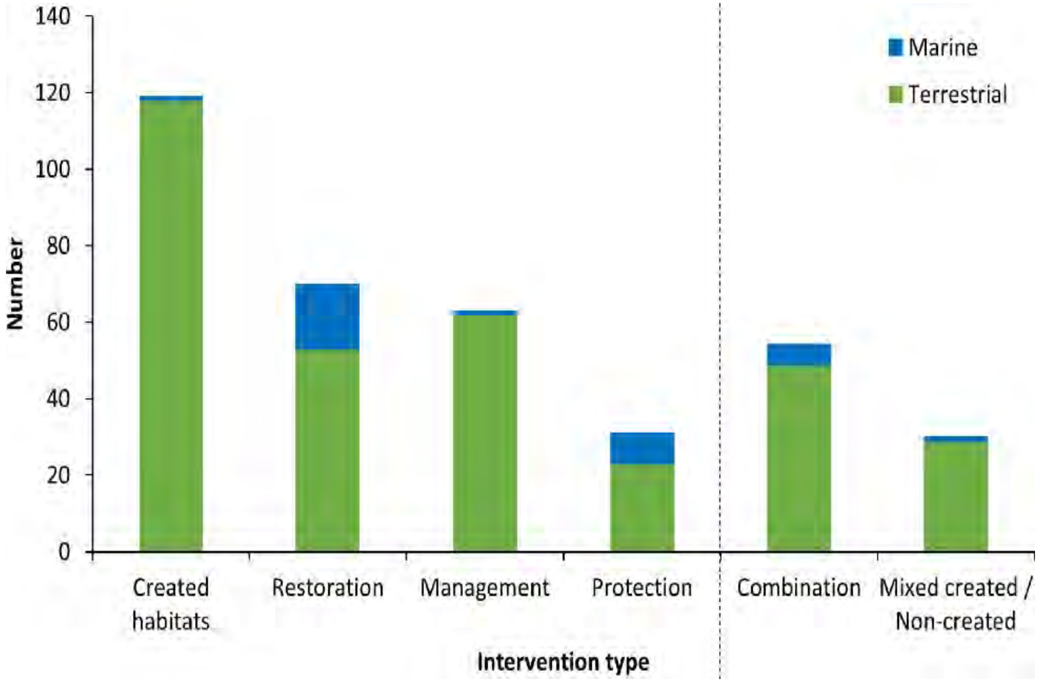
Riisager-Simonsen et al. 2022

Group work:

Have you been working with (coastal/marine) NBS projects before? What was the type of project, what the aim, what your role. Who was involved?

Limited uptake of coastal-marine NbS

- NbS have been largely studied for terrestrial, particularly urban systems, with less uptake in marine/coastal areas leading to fewer examples and experiences, despite an abundance of opportunities
- Marine restoration developed over a shorter period than restoration in terrestrial systems, partially explaining lower obs. efficiencies
- Political attention to date still low; efforts & techniques for restoring marine ecosystems comparatively new, technical and governance challenges exist, still relatively rarely implemented on large scale
- Most marine and coastal restoration projects have focused on developed countries, in particular Australia, Europe, and USA. Data from developing countries urgently needed, esp. for seagrass, saltmarsh, and oyster reefs, given that large numbers of people rely directly on their goods and services



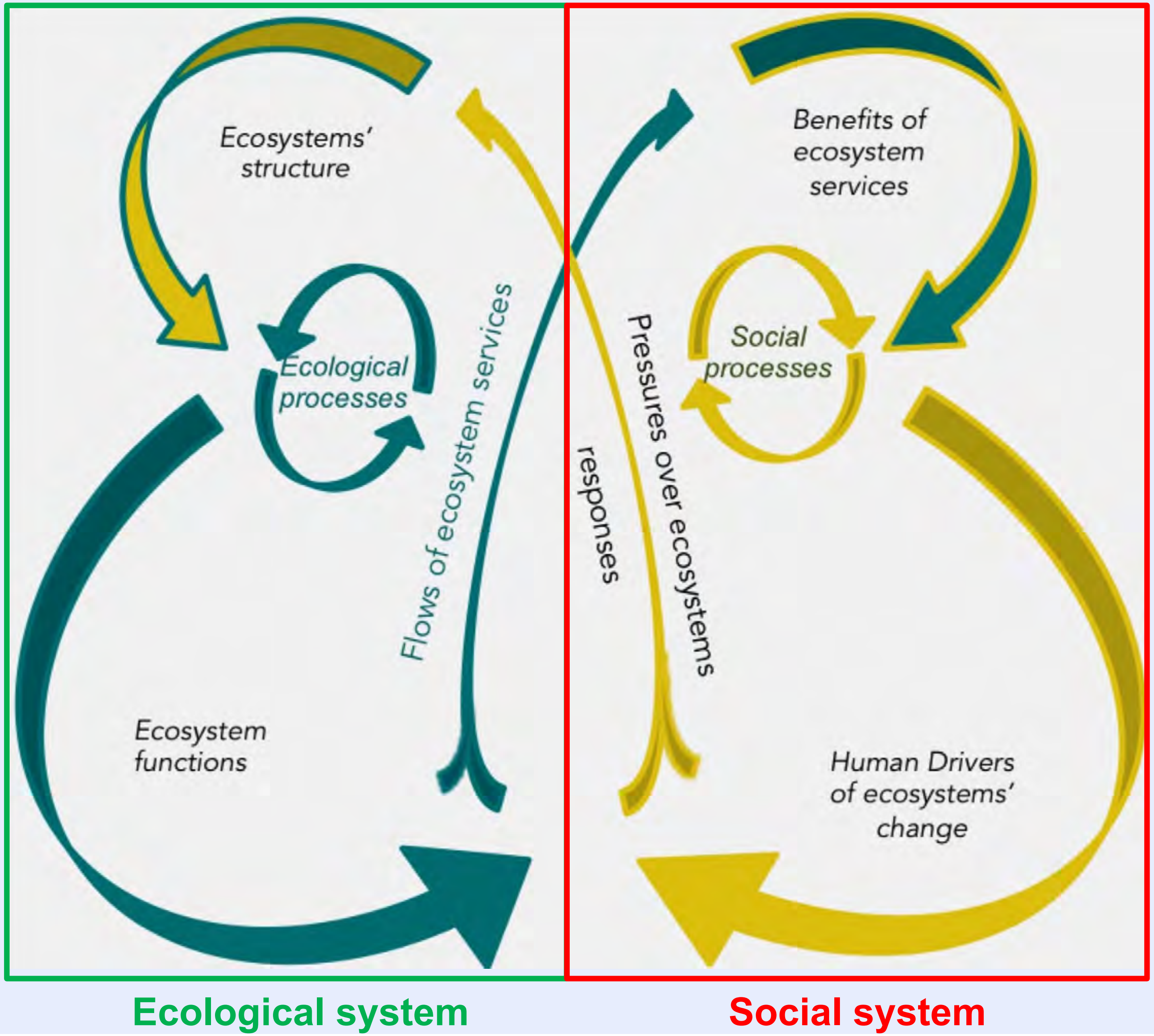
NbS Evidence Platform

Reasons to explain the slower implementation progress of NbS in marine and coastal ecosystems:

- Comp. sparse understanding on the mechanisms behind and quantity in which marine biodiversity and ecosystems deliver ecosystem services
- Interconnected social-ecological nature means marine and coastal NbS must be designed and operated at a seascape scale to be effective, considering the adjacent landscape and the social context of local populations or end-users
- Effective implementation requires greater public and policy awareness of the value of marine and coastal ecosystems.

O'Leary et al. 2023

The social-ecological system (SES)



Group work:

Develop restoration plans for specific marine and coastal habitats, incorporating the perspectives of various stakeholders, name responsibilities and allocate timescales

Background and context

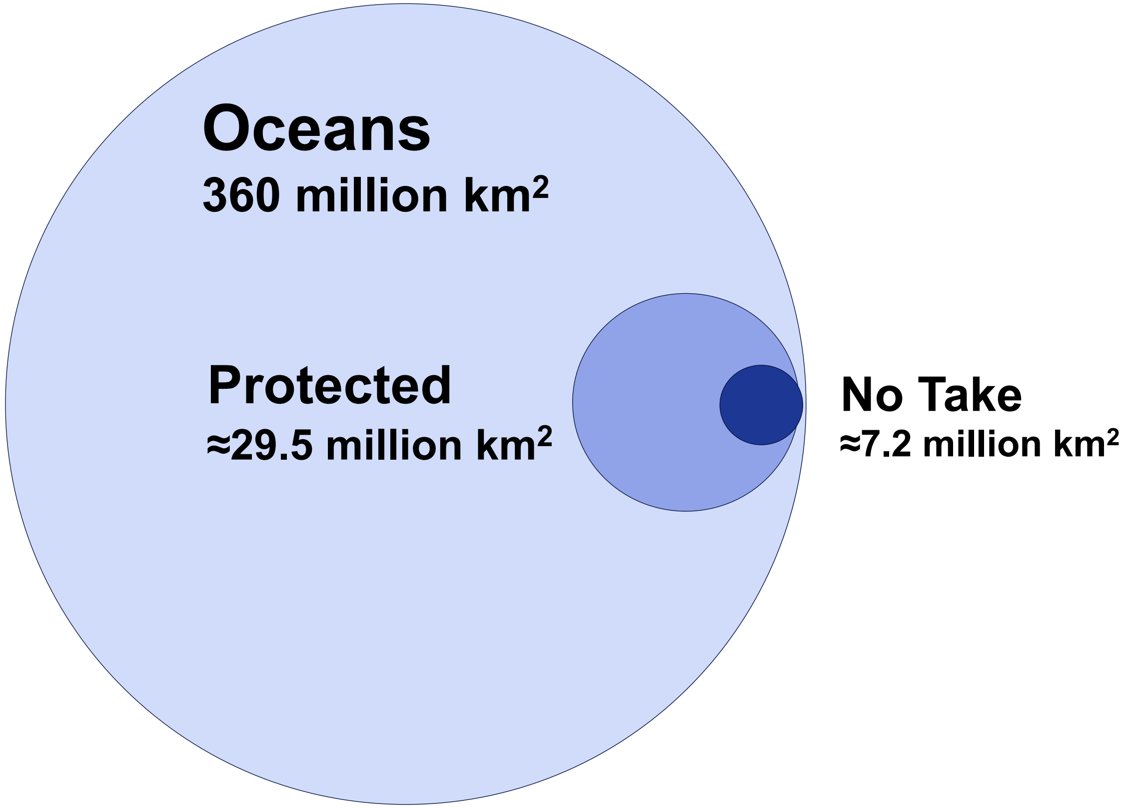
Part III Marine restoration: Aims, discourses, applications

Is protection not enough?

Global Coverage of MPAs 8,16%

BUT: Only **2.4 %** strictly protected

- Protection often exists only on paper - few effectively eliminate threats from activities such as fishing within MPA boundaries
- Problems with management effectiveness incl. connectivity constraints, lack of adequate monitoring etc.



A blueprint for conserving marine biodiversity

Marine reserves that are:

Connected
To other marine reserves

Large
Larger zones are more effective than smaller

Old
Have been protected over time

No-take
No extractive activities are permitted

Enforced
Compliance with restrictions is ensured

Deep
Extends from shore to deeper waters

provide increased conservation benefits

Marine Reserve

On average, Australian marine reserves had **28%** greater abundance (the number) and **53%** greater biomass (total weight) of fished species compared to areas open to fishing

Baited remote underwater video systems (BRUVs)
were used to sample 91 marine reserves around Australia. BRUVs can sample deeper waters off limits to divers and increase the proportion of fished species observed.

Goetze et al. 2021 Global Change Biology
DOI: 10.1111/gcb.15635

Restoration required for coastal/marine ecosystems

- Restoration measures need to be taken, especially where **natural regeneration processes are hindered or impeded**
- Restoring degraded marine ecosystems increases **ecosystem services**
- A growing body of research shows that **coastal and marine habitat restoration can help mitigate climate change** through carbon sequestration. Specifically, “blue carbon” is carbon captured and stored in marine, nearshore, and coastal systems, essential to meet both national and global biodiversity and climate targets and to counteract severe degradation
- Compared to terrestrial and freshwater environments, restoration of and in marine ecosystems presents a new mode of intervention with both technical and governance challenges.

Possingham et al., 2015; Fraschetti et al. 202; Abelson et al., 2020; Aronson et al., 2020; Filbee-Dexter et al., 2020; Shumway et al. 2021

Defining restoration

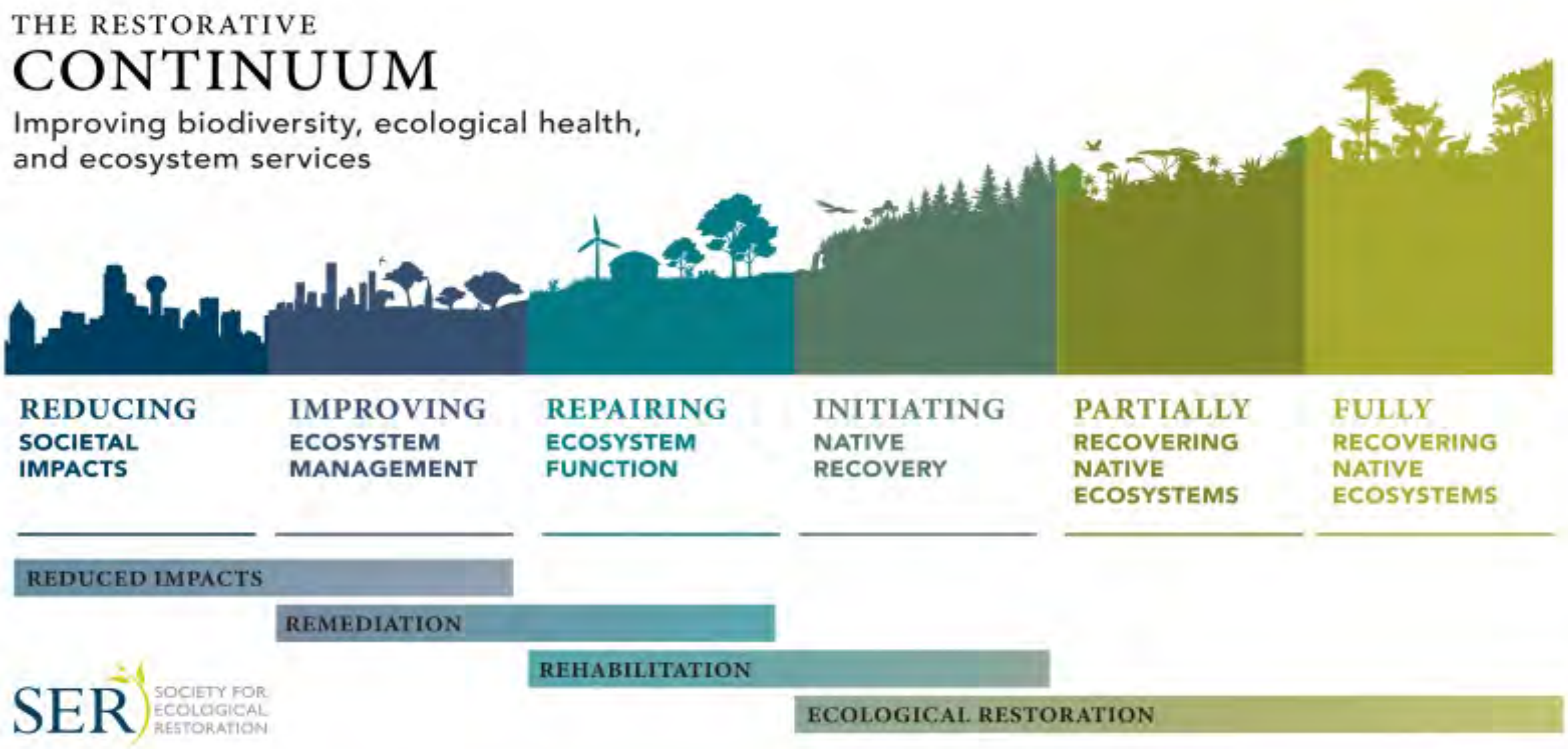
" the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed

Society of Ecological Restoration (2002)

From passive to active restoration

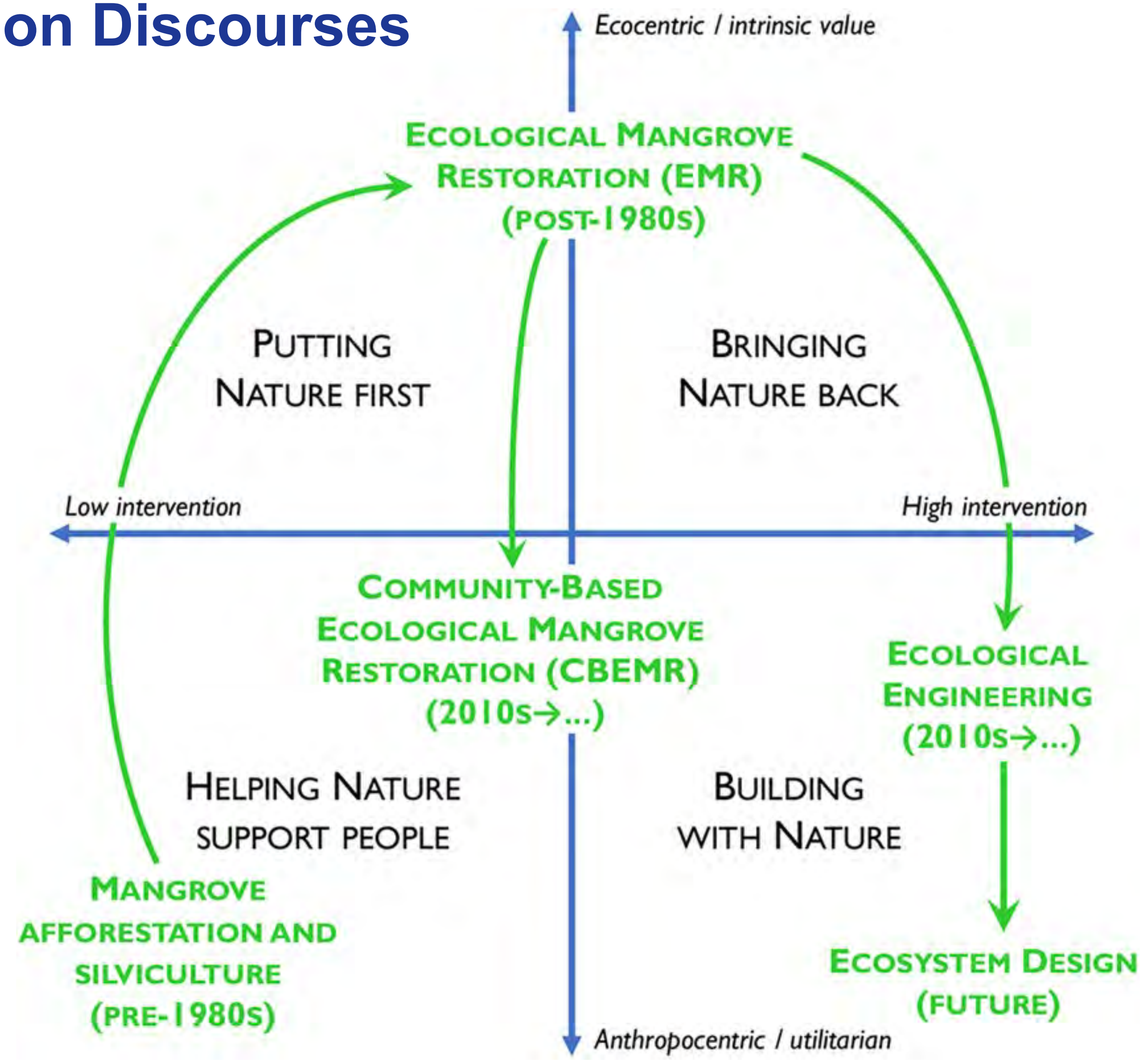
Ounanian et al. 2018

Restoration as NBS - Spectrum of human intervention



Gann et al., 2019

Types of Restoration Discourses



Ellison et al. 2020

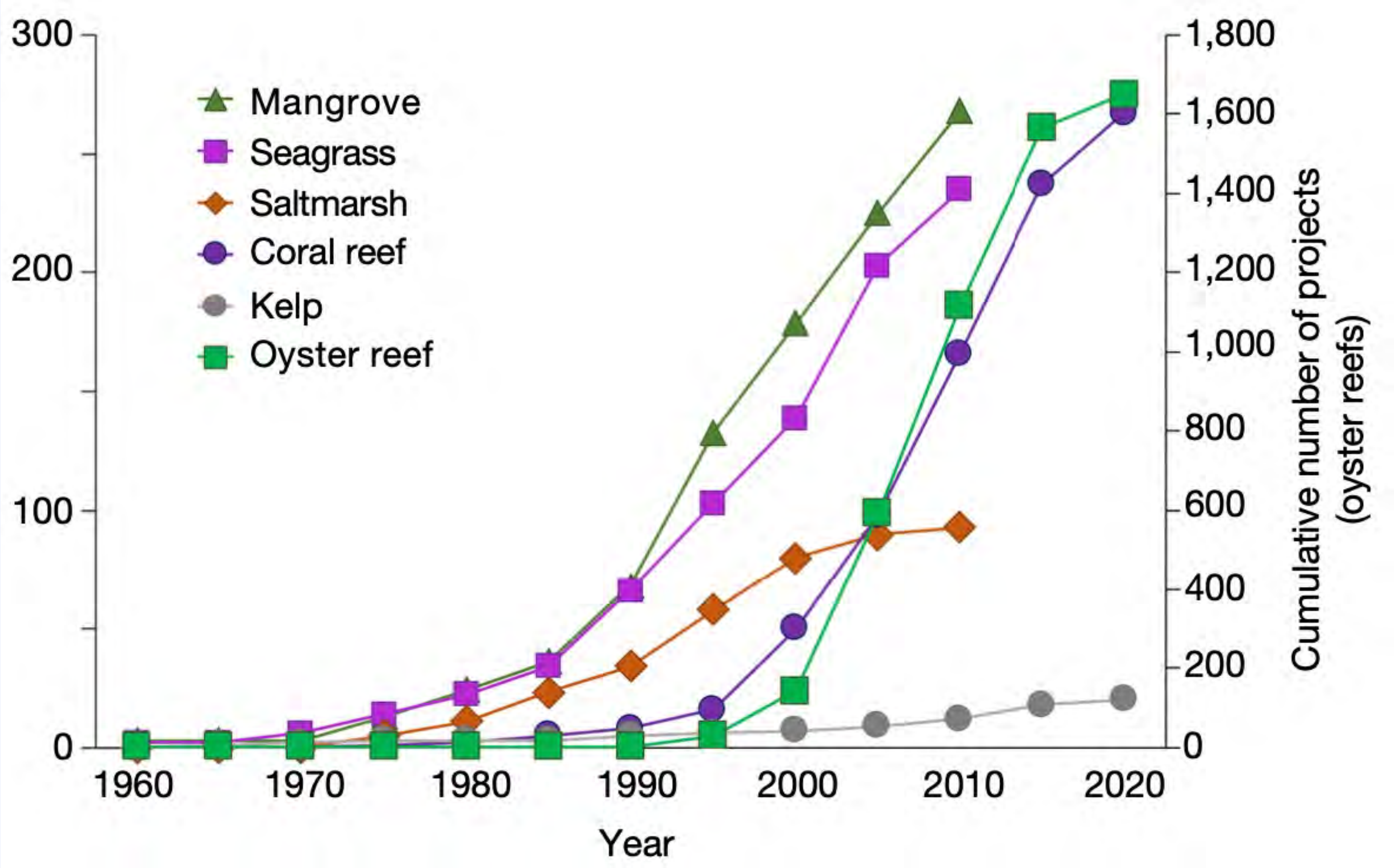
Ecological Restoration

"

aims to recover biodiversity and ecosystem functioning, health, and integrity, both for humans and for other living organisms

Clewell & Aronson (2012)

Global growth of restoration interventions for coastal/marine habitats



Large scale marine restoration projects

		Saltmarsh	Mangroves	Seagrass	Oyster reefs	Coral reefs	Kelp
(A) Large scale	Value (ha)	4550	195,000	125, expanded to 1,700	140	2	71
	Location	Delaware, USA	Sundarbans, Bangladesh	Virginia, USA	Maryland, USA	Sulawesi, Indonesia	California, USA

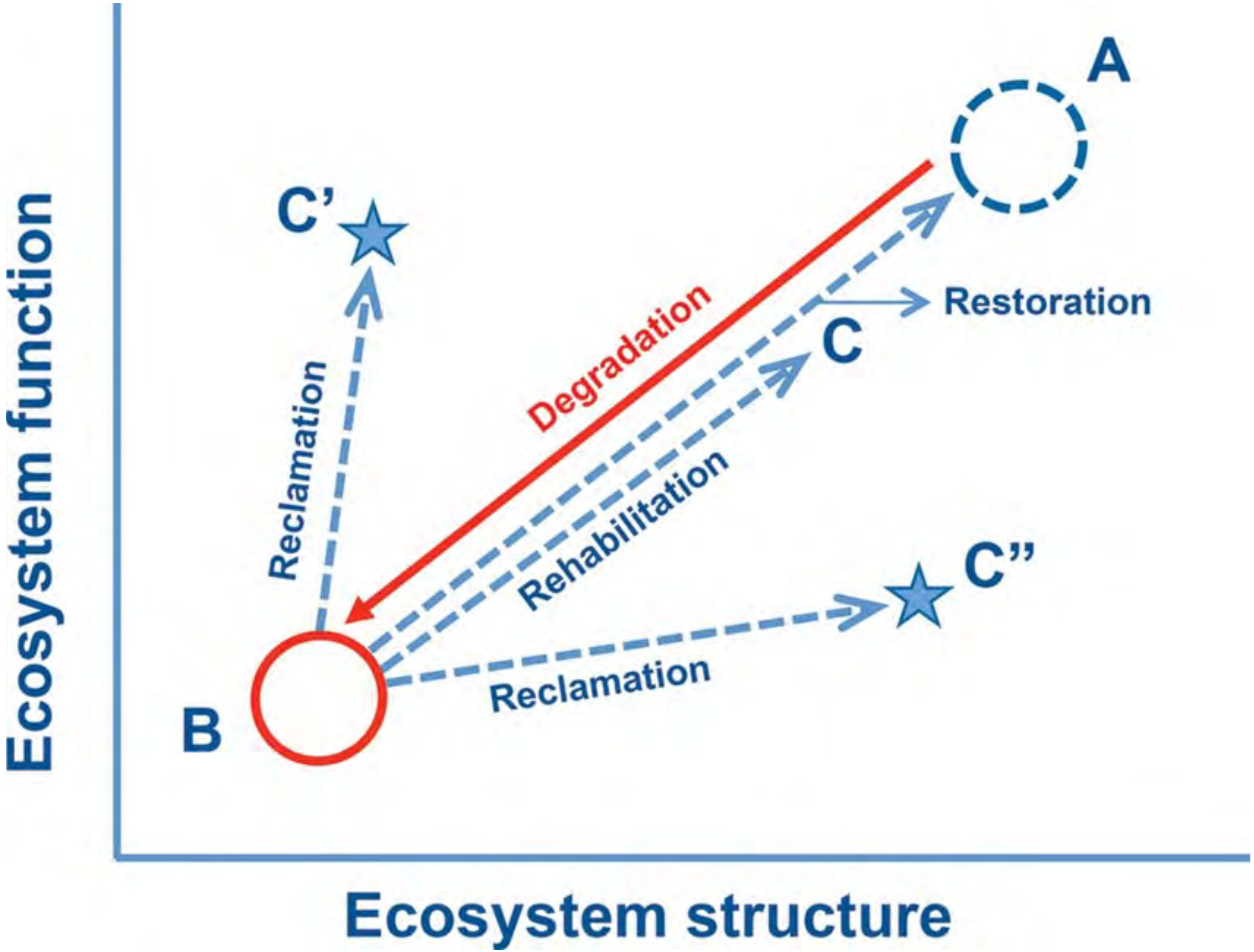
Saunders et al. 2020

UNEP WCMC, 2023

- Steady growth in the number of large-scale coastal and marine restoration projects around the globe, with an increase in the number of projects from 75 in 2015 to 118 in 2022.
- EUR 3.35 billion has been invested in seascape restoration from 2015, across 237 projects. Coral reefs were the most frequent habitat targeted for restoration, followed by mangroves and seagrass beds.
- Highest number of projects were found in Western Europe; however, the Asia-Pacific region received the largest amount of funding.
- Data gathering and sharing often be fragmented and incomplete, making it difficult to understand where restoration has worked and where the greatest potential is for strategic investment.

“The conservation, restoration and use of vegetated coastal habitats in eco-engineering solutions for coastal protection provide a promising strategy, delivering significant capacity for climate change mitigation and adaption.”

Clewell & Aronson (2012)


A
C'
Restoration
C
Degradation
Reclamation
Rehabilitation
C''
Reclamation
B
Ecosystem function
Ecosystem structure

Restoration timescales

- Marine species and habitats generally require 1-3 decades for substantial recovery but full recovery of processes, and ecological function may take even longer
- More heavily degraded habitats can be harder to restore
- Future pressures can affect the time taken for habitats to recover and their ability to reach desired outcomes (referred to as the 'target state')
- Continuous monitoring necessary

Wetlands	1-2	Partial recovery of site hydrology & mobile species such as birds arriving
	<10	Beneficial changes seen for vegetation & insects
	>60	Complete habitat recovery (for some wetlands)
Sand dunes	~33	Initial vegetation colonisation of bare sand
	5-20	Semi-fixed dunes
	>40	Fixed dunes and dune slacks
Saltmarsh	~5	Vegetation cover established (but typically not the same as non-restored community)
	~5	restoration of degraded invertebrate communities
	Up to 100	Full recovery of coastal processes, and ecological function

Holmes & Wentworth 2022

”

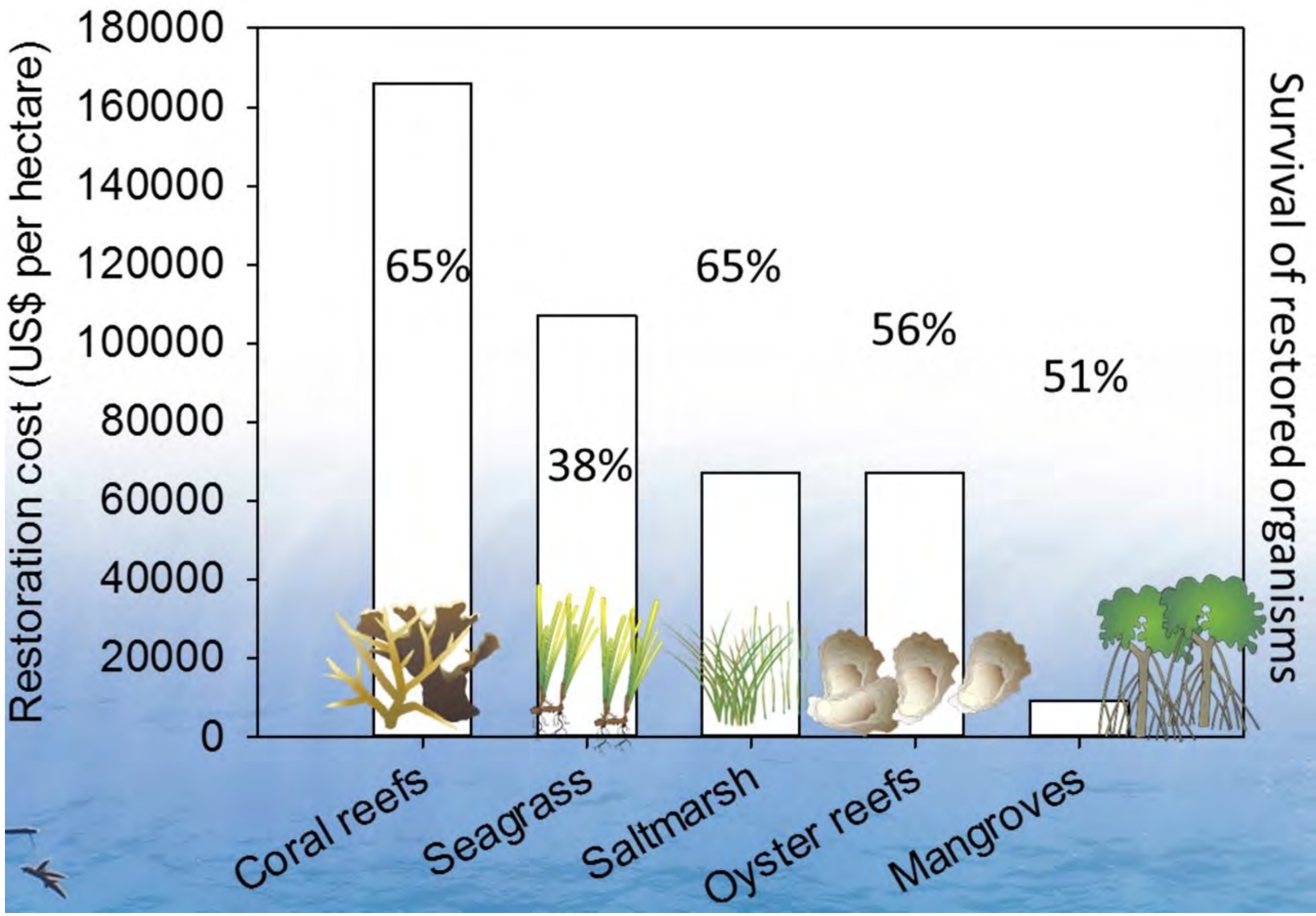
For restoration to be successful, it must effectively re-establish ecosystem functions and services to enhance human well-being

BUT

Successful restoration interventions are feasible only in environments with sustainable ecological regimes and where major pressures, including those arising from climate change, are effectively mitigated

Montefalcone et al. 2024

Cost and feasibility of marine coastal restoration



The median cost of coastal marine restoration is about US$80,000 per hectare but some projects are incredibly expensive, costing many millions of dollars.

Symbols – Integration and Application Network, University of Maryland Center for Environmental Science

Economic benefits

- Although accurate cost/benefit analyses are not possible due to lack of baseline data, there is evidence to support that the benefits of restoring marine ecosystems outweigh the costs.
- Although there may be some short-term losses to certain economic sectors, these are most likely outweighed by long-term gains. Particularly fisheries may benefit from increased catch in the medium to long term through the restoration of essential fish habitats.
- The economic benefits of restoring seagrass beds in the EU are estimated to be 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
- Leveraging the sustainable blue economy can help transform ecological restoration through commercial-scale enterprises, making significant contributions to global restoration efforts.

European Commission (2022); Filbee-Dexter et al. 2022

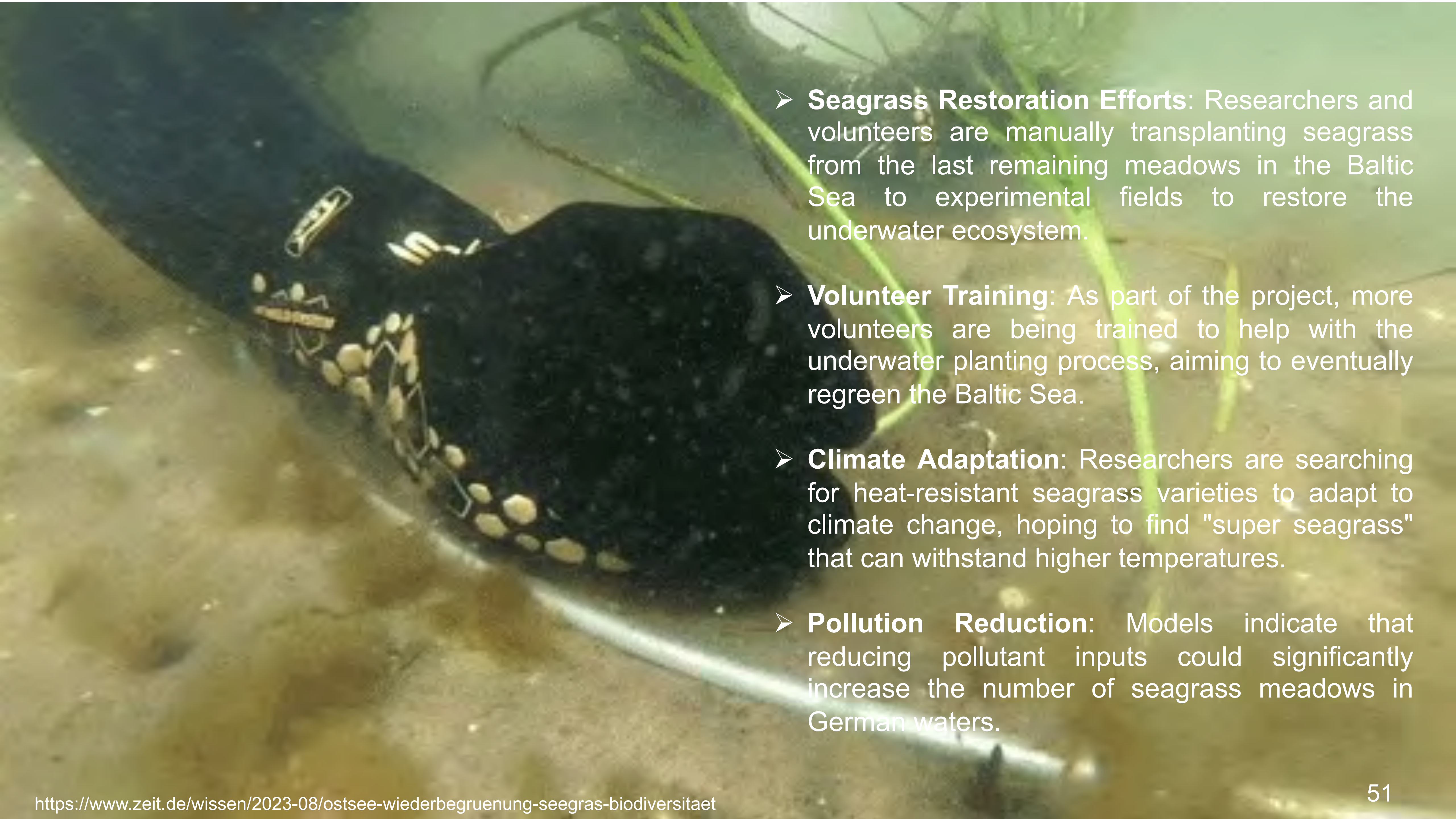
Seagrass project for climate protection

SeaStore
Diversity Enhancement Through Seagrass Restoration

- Seagrass meadows **promote high biodiversity** (ecosystem architects, nursery for invertebrates & fish) and provide important **ecosystem services** such as **carbon sequestration** (Seagrass meadows are among the most efficient CO_2 sinks of all)
- Seagrasses effectively **protect coasts**. They slow down waves, accumulate sand and stabilise sediment and prevent erosion far beyond their borders





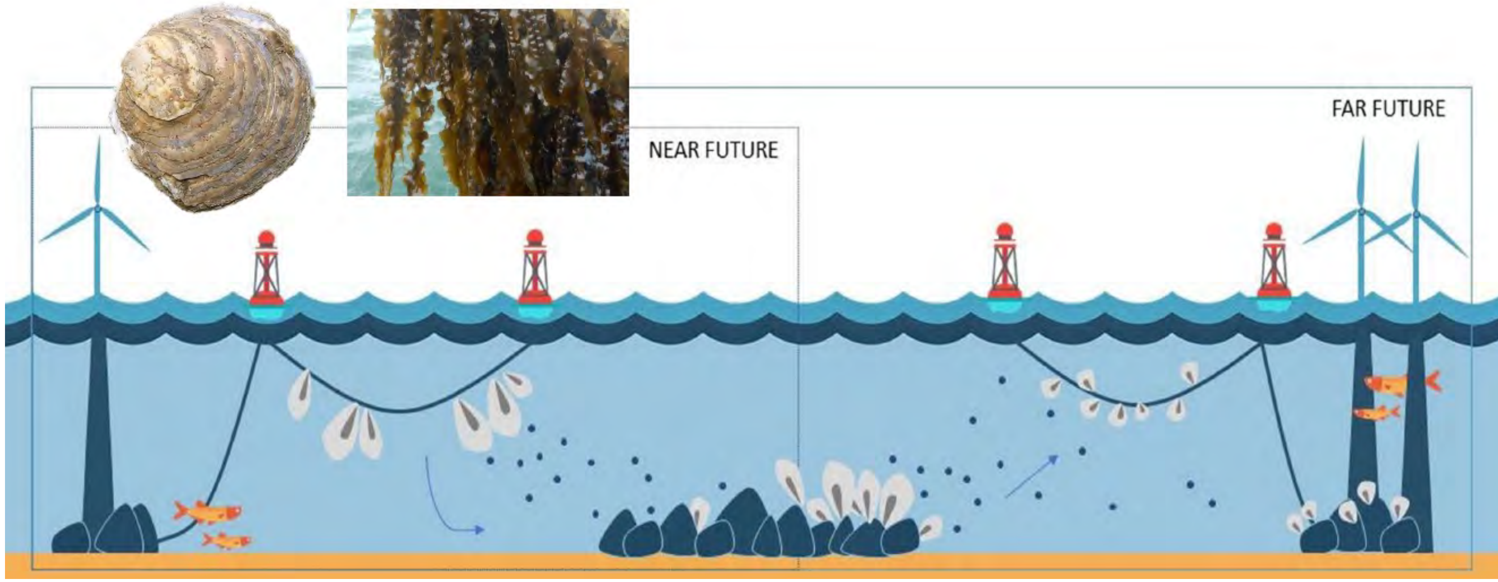


- **Seagrass Restoration Efforts**: Researchers and volunteers are manually transplanting seagrass from the last remaining meadows in the Baltic Sea to experimental fields to restore the underwater ecosystem.
- **Volunteer Training**: As part of the project, more volunteers are being trained to help with the underwater planting process, aiming to eventually regreen the Baltic Sea.
- **Climate Adaptation**: Researchers are searching for heat-resistant seagrass varieties to adapt to climate change, hoping to find "super seagrass" that can withstand higher temperatures.
- **Pollution Reduction**: Models indicate that reducing pollutant inputs could significantly increase the number of seagrass meadows in German waters.

https://www.zeit.de/wissen/2023-08/ostsee-wiederbegruenung-seegras-biodiversitaet

Ecosystem restoration as an integral part of ocean multi-use

- **Concept of Multi-use:** Innovative approach to marine space utilization, aiming to maximise benefits while reducing potential conflicts and environmental impacts (such as from offshore wind farms). By integrating various activities, we can create to promote both economic productivity and ecosystem restoration.
- **Collaboration is Key:** Successful implementation requires diverse and intense stakeholder engagement and collaboration - not just about good design; complex technical, regulatory, and socio-economic hurdles to overcome.
- **Learning from Case Studies:** Offshore wind, European flat oyster aquaculture & restoration, and seaweed cultivation in a Belgium Case illustrate the potential of multi-use.
- **Challenges:** far from large-scale application. Remote offshore sites, harsh sea conditions, specific biological requirements of target species complicate efforts. Obstacles can be overcome with innovative solutions and concerted efforts.



This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement no 862915

https://www.h2020united.eu/pilots/2-uncategorised/42-offshore-wind-and-flat-oyster-aquaculture-restoration-in-belgium; Figure: Annelies Declercp/Thomas Kerkhove

Coastal protection considerations

Protect people and property	AND	Reduce environmental and economical costs Enhance biodiversity and ecosystem services

- **Nature-based adaptation measures** can provide ecosystem services in addition to coastal protection. They can be more cost effective than hard engineering solutions, "use up less raw materials, increase system adaptability and present opportunities to improve ecosystem functioning." (van der Nat et al. 2016). However, further evaluations need to occur to determine true costs and benefits. Coral reef systems, for example, can be much cheaper to restore than low-crested detached breakwaters.
- **Wave attenuation**
  - Reduction of wave height or energy
- **Shoreline response**
  - Extent of erosion to built or natural infrastructure
  - Majority of literature is on restored dune habitats, in addition oyster reefs, saltmarsh planting
- **Flood water and storm surge attenuation**
  - Ability of coastal habitats to reduce the height or duration of flood waters
  - Less empirical data on this effect
  - E.g., dykes and natural mangroves, performance of dunes is variable, most compelling evidence is for saltmarshes with sills (e.g., rock)

Narayan et al. 2016

Opportunities for nature based coastal protection

- Increasing interest in natural defense systems as opposed to hard defense structures. Effects of natural solutions can be additive
- Ability of natural defenses to prevent erosion, storm surge flooding, land loss over time, inundation due to sea level rise
  - Ecosystem processes provide protection via increased bed friction, shallowing of water, sediment deposition and building vertical biomass
- Seagrasses, salt marshes, and mangroves can reduce water flow and wave height (similar with reef systems)
  - Coral reefs can reduce wave height by 70%, saltmarshes 72%, seagrasses and kelp beds 36% and mangroves 31%
  - Saltmarsh stabilization dependent upon surrounding vegetation and environmental setting
  - Lack of info on effectiveness of shellfish reefs, possibly due to their widespread destruction
- Subtidal habitats cause water shallowing (encouraging wave breaking)
- Coastal vegetation and shellfish reefs can stabilize shorelines, promoting sediment deposition, reducing erosion and sediment movement. Sediment accumulation can fortify/raise the land level.

Morris et al. 2019

Challenges

- Hard infrastructure costs are high and can damage the ecosystem where it's being implemented. They support less diversity than natural measures & often feature invasive species.
- Testing between traditional and nature-based adaptation methods can be difficult to do under the same environmental conditions
- Variability in results among studies highlights the need to identify not only which habitats are effective at providing coastal defense, but also under what range of physical conditions (i.e., what locations and types of environments).
- Further, as with natural habitats, the design of soft engineering projects (e.g. tidal height, length and width, density of organisms) will impact effectiveness.
- Lack of evidence on the long-term effectiveness of created habitats (therefore need more research)

Narayan et al. 2016

Eco-engineering

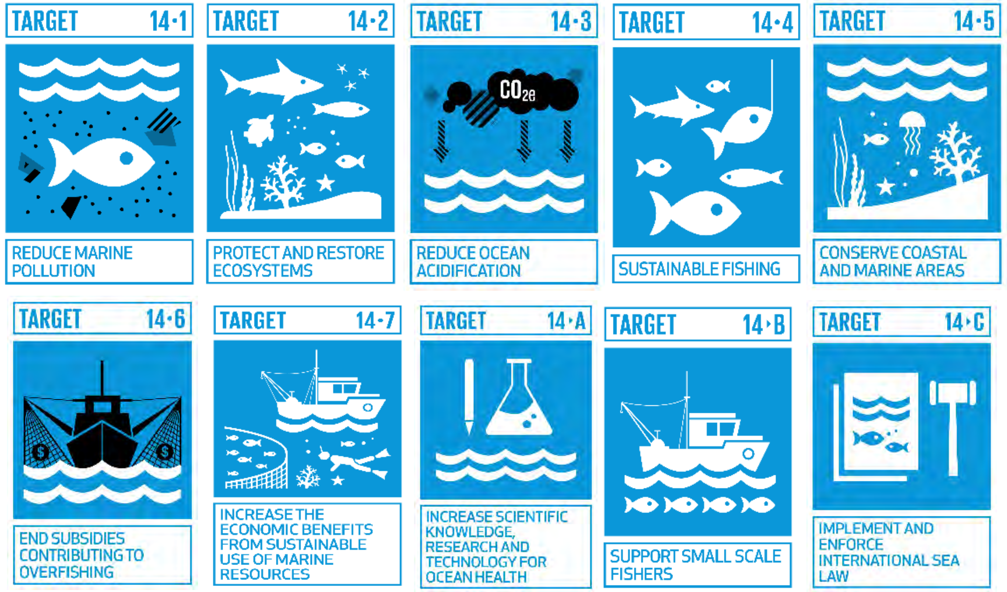
- There is an interest in ecological engineering, combing natural solutions with artificial infrastructure, to benefit both humans and nature

- **Hard, hybrid, and soft eco-engineering**
  - **Hard:** used in places where it’s not possible to use soft engineering techniques
  - **Hybrid**: nature-based and built infrastructure combined
  - **Soft:** Usually habitat restoration, creation, or enhancement for the purpose of climate change mitigation and adaptation as an alternative or complement to artificial structure

Block II: Policy frameworks

Policy Framework

"Conserve and sustainably use the oceans, seas and marine resources for sustainable development"



Source: © https://sdgs.un.org/goals refers to all SDG icons

The new Global Biodiversity Framework (GBF)

- At the 15th Conference of the Parties to the Convention on Biological Diversity (**CBD COP15**) in Montreal in December 2022, the new GBF was adopted with 4 long-term targets by 2050 (Goals A-D) and 23 action-oriented targets by 2030 (Targets 1-23).
- The target on ecosystem restoration is found under **Goal A Target 2**:
  - **By 2030, at least 30%** of degraded ecosystems should undergo restoration actions, including to improve their ecological functions and connectivity. This includes marine and coastal systems.
  - The specification of 30% of degraded area represents a **doubling** of the 15% target of the previous Aichi Target 15, which was not achieved.
  - It remains to be seen whether the Parties will succeed this time in translating the GBF targets into **national targets and successfully implementing systematic monitoring and adaptive management** through mainstreaming in all sectors

CBD, 2022; Perino et al., 2022

14.1: By 2025, prevent and significantly **reduce marine pollution**

14.2: By 2020, **sustainably manage and protect marine** and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans

14.3: Minimize and address the impacts of **ocean acidification**

14.4: By 2020, effectively regulate harvesting and **end overfishing,** IUU fishing and destructive fishing practices in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield

14.5: By 2020, **conserve at least 10 per cent** of coastal and marine areas

14.6: By 2020, **prohibit harmful fisheries subsidies**

14.7: By 2030, **increase the economic benefits to Small Island developing States** and least developed countries from the sustainable use of marine resources

14a: Increase scientific knowledge in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries

14b: Provide access for small-scale artisanal fishers to marine resources and markets

14c: Enhance the conservation and sustainable use of oceans and their resources by implementing **international**

https://sdgs.un.org/goals; UNEP, 2021; Andriamahefazafy et al. 2022

The UN Decades for Ecosystem Restoration & Ocean Science for Sustainable Development

Ecosystem Restoration

Aim: To prevent, halt, and reverse the degradation of ecosystems worldwide.

Approach: By driving political and societal support that foster large-scale restoration practices, the Decade aims to enhance ecosystem resilience, improve biodiversity, and create a healthier environment.

- **Initiatives:** Bonn Challenge and its regional initiatives AFR100 (Africa) and Initiative 20x20 (Central and South America)
- Promoting ”green" **jobs, partnerships and cooperation** at all levels from international to local to achieve ambitious restoration targets

Ocean Science

Aim: To support efforts to reverse the decline in ocean health and gather ocean stakeholders worldwide behind a common framework for sustainable ocean science.

Approach: Science-policy interface / science-based management. The Decade aims to improve the scientific understanding of the ocean to inform policies and management practices. This will help in developing and implementing more effective marine restoration strategies.

- **Role of Restoration:** Marine ecosystem restoration as a key strategy for mitigating climate change, bolstering biodiversity, and sustaining blue economies.
- **Capacity Building and Knowledge Sharing**

The BBNJ-Agreement

Historic global agreement for the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (years in the making).

Formal Adoption: The treaty comes into force post ratification by 60 states and a 120-day waiting period.

Objective: The primary aim of the BBNJ Agreement is the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction (ABNJ), crucial for the sustained health of marine ecosystems.

Key Terms (Article 1):

- **Area-based Management Tool:** Tool for managing a geographically defined marine area to achieve conservation and sustainable use objectives.
- **Marine Protected Area (MPA):** Marine area managed for specific long-term biodiversity conservation objectives. May allow sustainable use if consistent with conservation objectives.

Potential for Restoration: Global mandate for passive restoration efforts aimed at rehabilitating marine ecosystems and maintaining biodiversity: landmark in the global effort to safeguard at least 30% of the world's oceans through the establishment of extensive MPAs.

Challenges:

- Fisheries regulated under international law and managed by Regional Fisheries Management Organizations (RFMOs) are exempt from some provisions. BBNJ mandates collaboration with RFMOs where MPAs may impact or overlap with their operations.
- High Seas Dual Perspective remains: Balancing the high seas as global commons shared by all humans vs. freedom of the high seas.

https://www.un.org/bbnj/sites/www.un.org.bbnj/files/draft_agreement_advanced_unedited_for_posting_v1.p

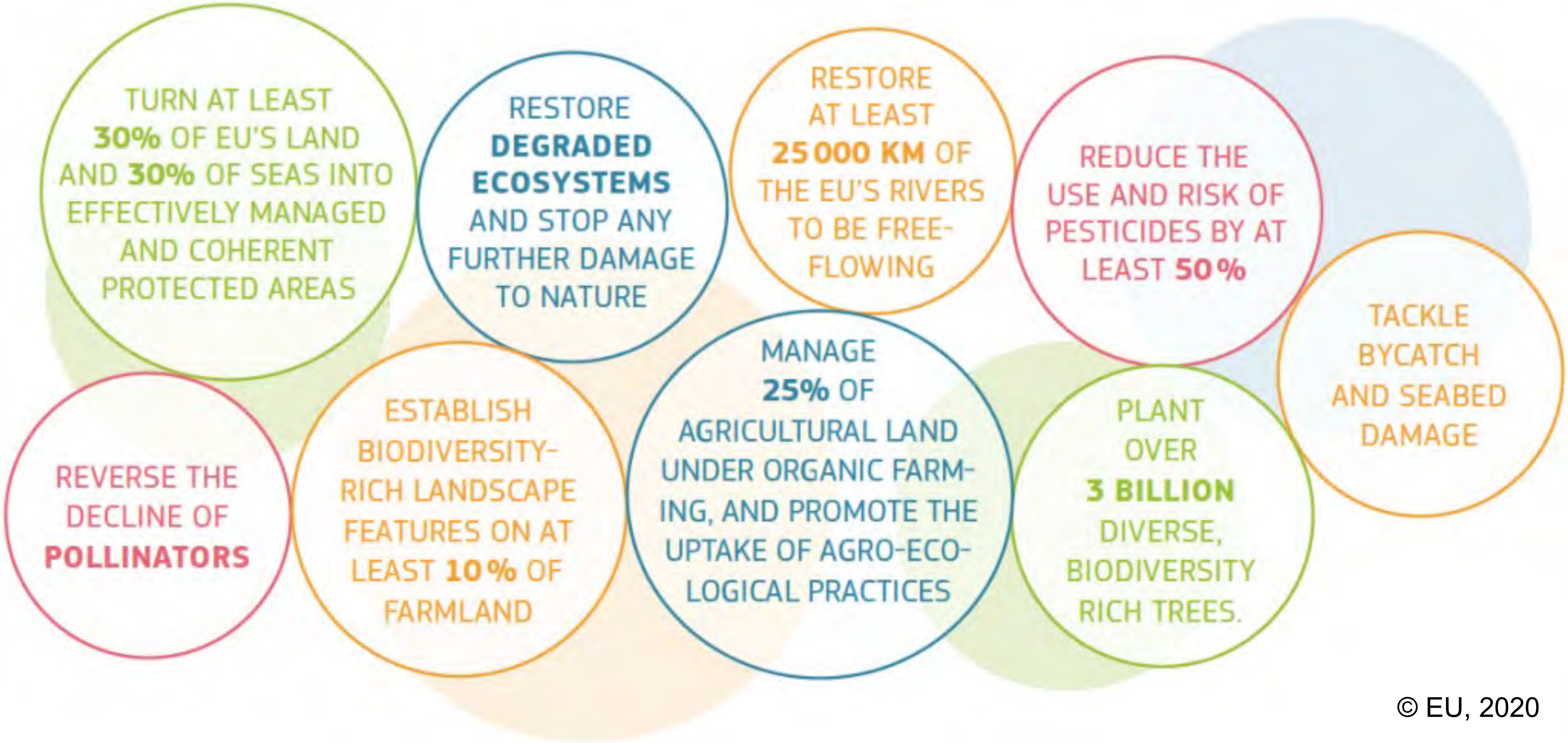
The Marine Strategy Framework Directive

- **Objective:** to protect and preserve the marine environment, prevent its deterioration and restore the environment in areas where it has been adversely affected.
- **Aim:** to achieve or maintain ‘good environmental status’ (GES) in EU marine waters
- MSFD covers marine waters within the sovereignty or jurisdiction of Member States as well as the seabed and subsoil. Each Member State is obliged to develop a Programme of Measures (PoM) to meet the objective of GES
- **Monitoring via 11 Descriptors**

EU Biodiversity Strategy for 2030 *"Bringing nature back into our lives"*

- **Objective**: put Europe's biodiversity on the path to recovery by 2030, for the benefit of people, climate and the planet.

Targets:



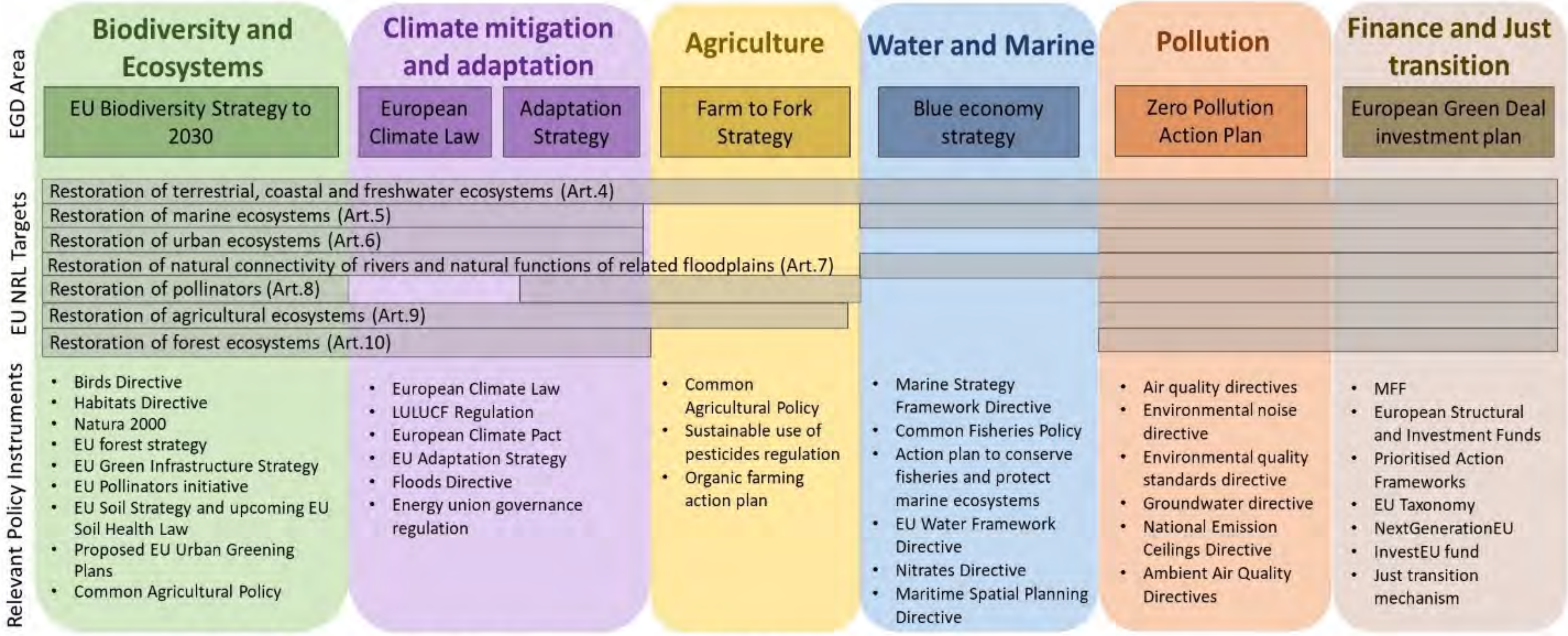
The EU Nature Restoration Law

- **Key Provisions:** This ambitious framework aims to restore ”at least 20% of the EU’s land and sea areas by 2030 and all ecosystems in need of restoration by 2050” **(Article 1)**
- **Restoration of ecosystems:** put in place restoration measures for the habitats of species protected by the Habitats and Birds Directives, as well as several other habitats/species
- **Approval and Next Steps:** The EU Parliament voted in favor of the NRL on July 12, 2023. The final form will be negotiated in a trilogue procedure between the Parliament, Council, and Commission.
- **Monitoring Progress:** The NRL calls for measuring and monitoring these binding targets, with evaluations set for 2030 and 2040.

European Commission, 2022; Oceana 2022

Content of the NRL proposal

Contribution of the NRL to other EU environmental policies



Abbreviations: **EGD**: EU Green Deal, **NRL**: Nature Restoration Law, **MFF**: Multiannnual Financial Framework

Source: IEEP

Content of the NRL proposal

Area-based restoration targets

Article 4	• Restoration of terrestrial, coastal and freshwater ecosystem
Article 5	• Restoration of marine ecosystems
Article 6	• Restoration of urban ecosystems
Article 7	• Restoration of the natural connectivity of rivers and natural functions of the related floodplains
Article 9(4)	• Restoration of agricultural ecosystems – drained peatlands under agricultural use

Source: IEEP

Breaking news: Nature restoration law adopted

Parliament adopts law to restore 20% of EU’s land and sea

17 June 2024

https://www.consilium.europa.eu/en/press/press-releases/2024/06/17/nature-restoration-law-council-gives-final-green-light/

Need for stable policy domains

Legitimacy in governance:

- Ensuring stakeholder participation, quality decision-making, and effective outcome delivery.

Scaling and coordination:

- Aligning local initiatives with broader EU goals.
- Enhancing regional and transboundary cooperation (e.g., Regional Sea Conventions).
- Facilitating knowledge sharing and resource pooling among regions.

Strategies for impact:

- Promoting active dialogue between agencies to overcome national boundaries.
- Encouraging public-private partnerships for resource mobilization and innovation.
- Implementing monitoring and evaluation frameworks to track progress and adapt strategies.
- Addressing incomplete knowledge, unpredictability, and ambiguity

Ecosystem-based management (EBM)

EBM is a **reversing the order of management priorities to start with the ecosystem rather than the target species** (Pikitch et al. 2004)

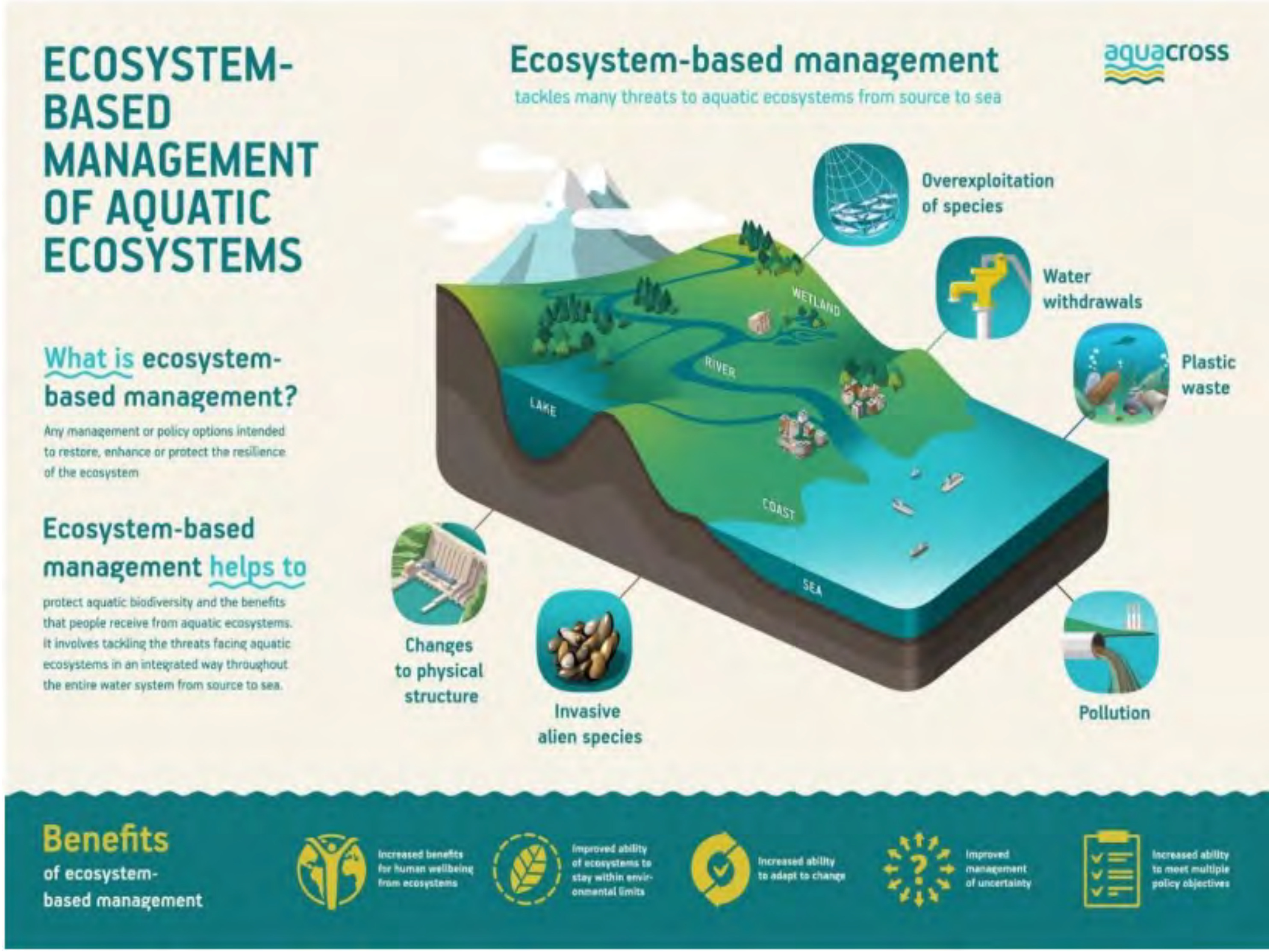
EBM rationale: whilst the **ecosystem** itself may **not be managed,** the **human uses and activities that interact and impact upon the ecosystem may be managed** to conserve biodiversity and ensure sustainable development (Long 2012)

Aim: to **preserve ecosystem structure and functioning** to ensure the **ongoing provision of products and services**.

Therefore, management of the impacts of human activities must focus on the entire **social-ecological system** and not its component parts.

Move away from traditional sectoral management approaches towards those that are integrated, adaptive and coherent across policy domains

Delacámara et al. 2020


ECOSYSTEM-BASED MANAGEMENT OF AQUATIC ECOSYSTEMS
What is ecosystem-based management?
Any management or policy options intended to restore, enhance or protect the resilience of the ecosystem
Ecosystem-based management helps to
protect aquatic biodiversity and the benefits that people receive from aquatic ecosystems. It involves tackling the threats facing aquatic ecosystems in an integrated way throughout the entire water system from source to sea.
Ecosystem-based management
tackles many threats to aquatic ecosystems from source to sea
aquacross
Overexploitation of species
Water withdrawals
Plastic waste
WETLAND
RIVER
LAKE
COAST
SEA
Changes to physical structure
Invasive alien species
Pollution
Benefits of ecosystem-based management
Increased benefits for human wellbeing from ecosystems
Improved ability of ecosystems to stay within environmental limits
Increased ability to adapt to change
Improved management of uncertainty
Increased ability to meet multiple policy objectives

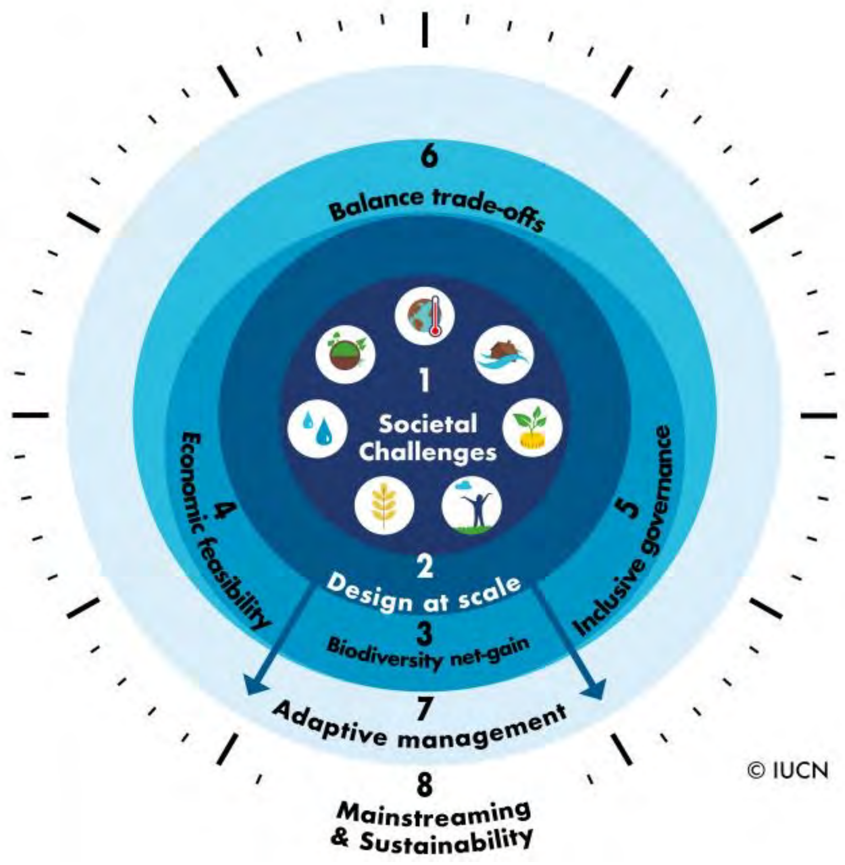

Aquacross case studies
WHAT DOES ECOSYSTEM-BASED MANAGEMENT INVOLVE?
It is carried out at appropriate spatial scales
EXAMPLE: RIVERS OF THE SWISS PLATEAU
Optimal restoration measures were identified at the catchment scale, rather than at the scale of individual rivers
EXAMPLE: RIA DE AVEIRO, PORTUGAL
A planning process is co-developed across the river, coastal and marine area to avoid unintended consequences of management measures
It uses adaptive management to handle uncertainty in how ecosystems respond to management measures
EXAMPLE: LOUGH ERNE, NORTHERN IRELAND
Considers raising water levels in the lake alongside farm best management practices to manage long-term impact of invasive alien species
It develops and uses multi-disciplinary knowledge
EXAMPLE: NORTH SEA
A risk-based approach was used to compare management measures that reduced risks to biodiversity while achieving other societal goals
EXAMPLE: LAKE RINGSJÖN, SWEDEN
Social and ecological dynamics were modelled to understand the lake's responses to restoration measures
It builds on social-ecological interactions, stakeholder participation and transparency
EXAMPLE: MARINE PROTECTED AREA, AZORES
Stakeholders identified shared objectives: long-term sustainability, monitoring and compliance with legislation, participatory and holistic management
It supports policy coordination
EXAMPLE: DANUBE RIVER
Optimal sites identified for ecological restoration to meet objectives of several policies including the Water Framework Directive and the Biodiversity Strategy
It considers ecological integrity, biodiversity, resilience and ecosystem services
EXAMPLE: INTERCONTINENTAL BIOSPHERE OF THE MEDITERRANEAN (SPAIN-MOROCCO)
Biodiversity and ecosystem services were modelled across the region to design a network of green and blue infrastructure
aquacross

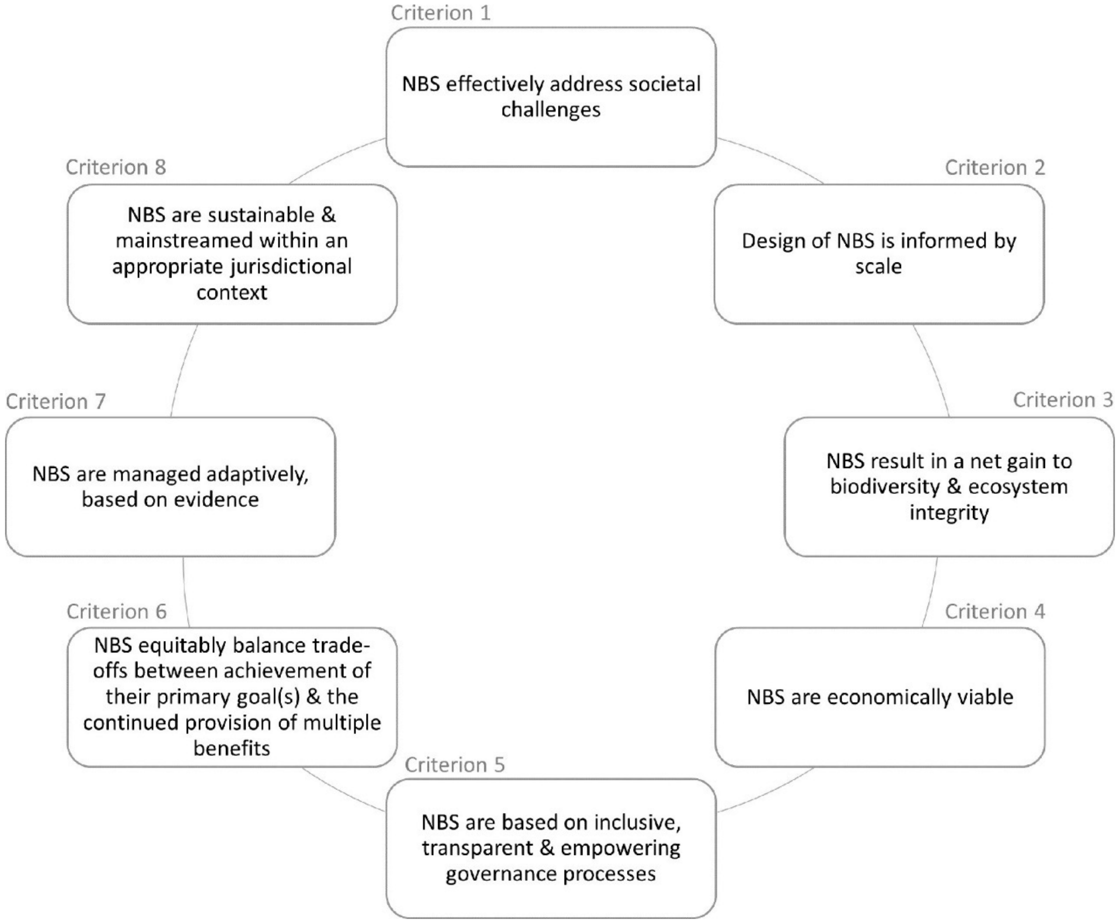
Block III: Upscaling

Upscaling

Part I Established best practices for NbS implementation

IUCN Global Standard for NbS





Cohen-Shacham et al. 2019; O'Leary et al. 2023

Use NbS as planning tool

- Using the NbS concept for planning and implementation of interventions such as restoration can **strengthen transdisciplinary approaches and participatory methods** which bring together stakeholders from policy, academia, civil society, and the private sector. Thus, NbS can help overcome conflicts and trade-offs.

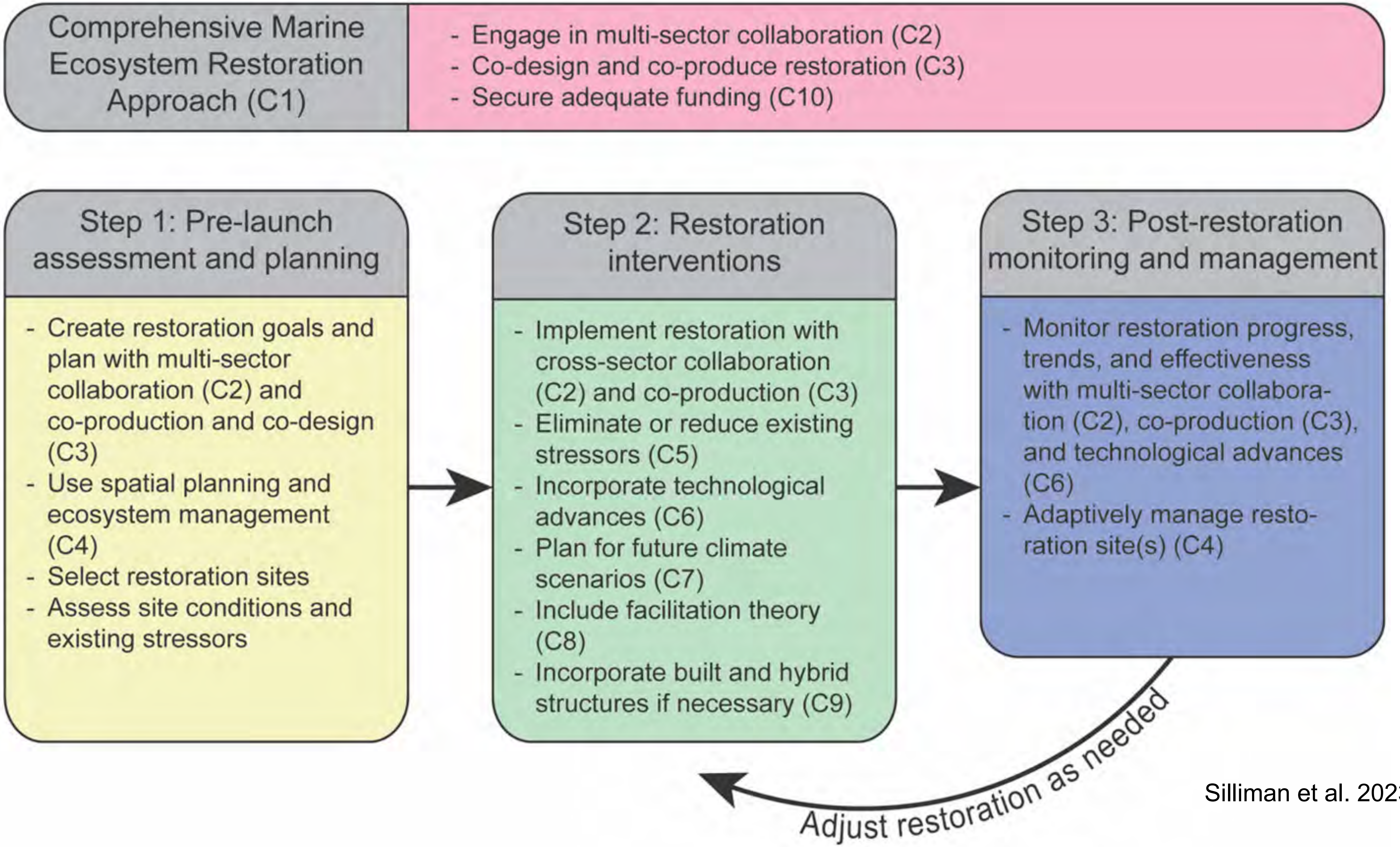
- The **development of clear guidelines, standards, safeguards,** and participation and grievance mechanisms can minimize risks and contribute to implementation success.

- **Existing concepts** like ecosystem services could provide a useful common basis for evaluating the impacts of different measures. The knowledge gained in this way should be used to select the most suitable NbS strategy for each local situation (e.g., insurance, sustainable innovation, etc.).

- The **planning process** should always also address the underlying drivers of ecosystem degradation.

- **Best Practices** that show how evidence- and criteria-based planning help resolve conflicting goals

Nesshöver et al., 2017; Fang et al., 2022



Silliman et al. 2023

Established best practices for NbS implementation

https://networknature.eu/product/22250

Gann et al. 2019

FAO, 2021

https://ser-rrc.org/

https://www.unep.org/gan/resources/toolkits-manuals-and-guides/options-ecosystem-based-adaptation-coastal-environments

Case study collections

Table 1. Overview of European NBS case study collections (status March 2022)

Project name	Link to NBS case study collection / NBS databases	Geographic coverage	Total cases collected	Cases in Nordic countries
Oppla	https://oppla.eu/case-study-finder	global	327	Ca. 17
Network Nature	https://networknature.eu/network-nature-case-study-finder	global	396	Ca. 16
Urban Nature Atlas (Naturvation project)	https://una.city/	global, focus on cities	1105	71
Natural Water Retention Measures	http://nwrm.eu/list-of-all-case-studies	mainly Europe, focus on water	372	7
Nature-based solutions Initiative	https://casestudies.naturebasedsolutionsinitiative.org/	global	110	0

https://pub.norden.org/temanord2022-562/#120903

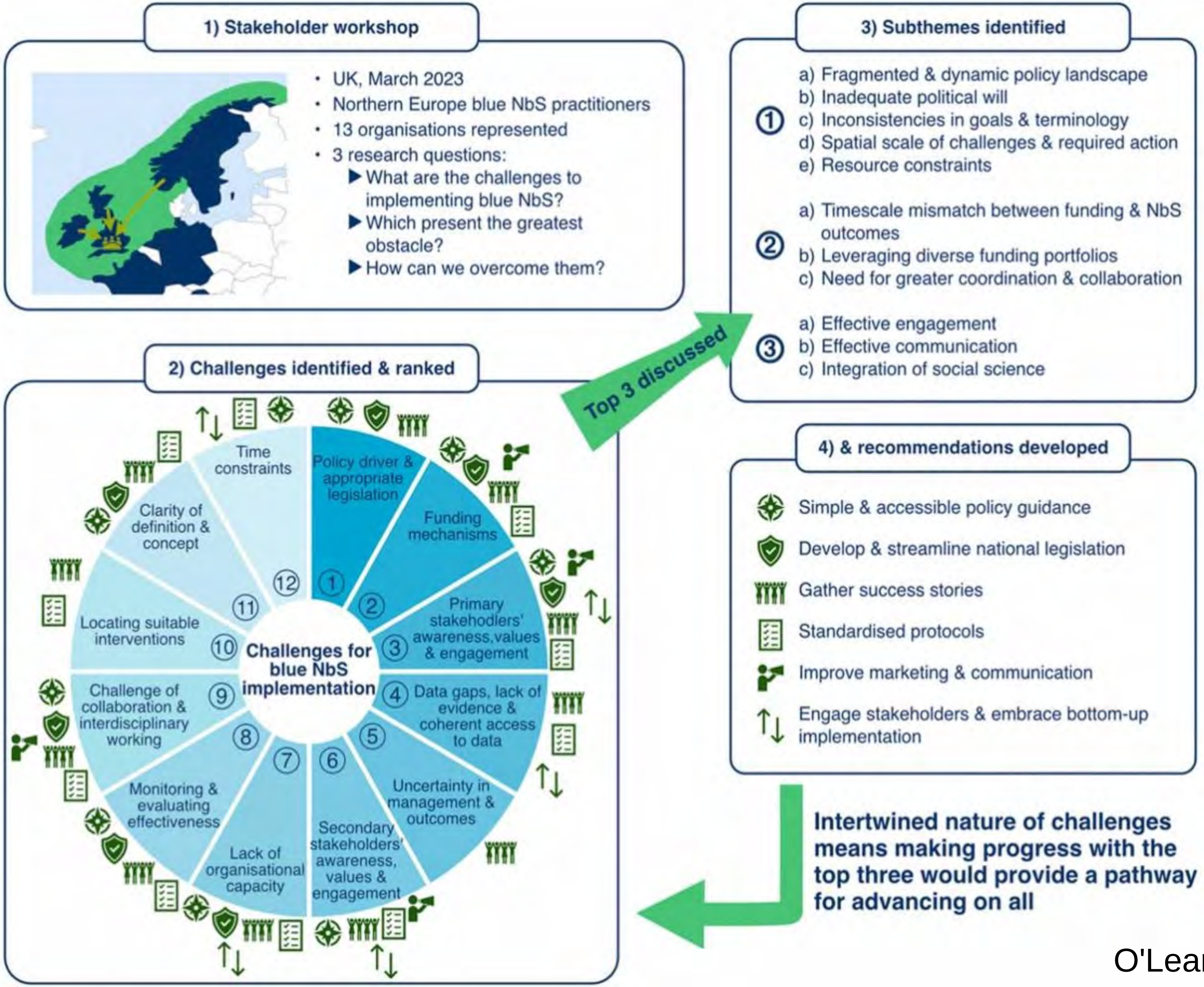
Upscaling

Part I Key challenges, opportunities and recommendations

Scaling up the implementation of [coastal and marine NbS] has the potential to trigger the transformative change in sustainable management needed to deliver on biodiversity, climate, development, and health targets

(IUCN 2020)

Image © Unsplash



O'Leary et al. 2024

Key Challenges

- Pressure on biodiversity is continuing to increase (including from new & emerging threats and illegal activities)
- Knowledge of ecosystem management & restoration is currently inadequate for meeting the challenge of increasing production while sustaining ecosystem services
- Financial investment in biodiversity conservation/restoration needs to be scaled up enormously (order of magnitude)
- Socioecological Complexity (conflicting interest, managing trade-offs, finding synergies, etc.)

For marine coastal restoration, we do not currently know:

1. whether the best practice standards toward a full ecosystem recovery proposed by SER have been applied
2. which metrics have been measured to assess recovery
3. what the intended outcomes for the restoration projects were

Seddon et al., 2021

Recommendations

- To progress marine and coastal NbS, O'Leary et al. (2023) suggests, for example, to 'layer up' existing approaches by conducting active restoration within MPAs and testing new approaches, including large-scale and smaller linked NbS, as part of 'climate-smart' MSP
- Short- and long-term interventions with complementary objectives could be combined as an NbS, enabling interventions to achieve synergistic effects (Sánchez-Arcilla et al. 2016).
- Restore across entire seascapes: multi-habitat & from source-to-sea, fostering increased connectedness (McAfee et al., 2022)

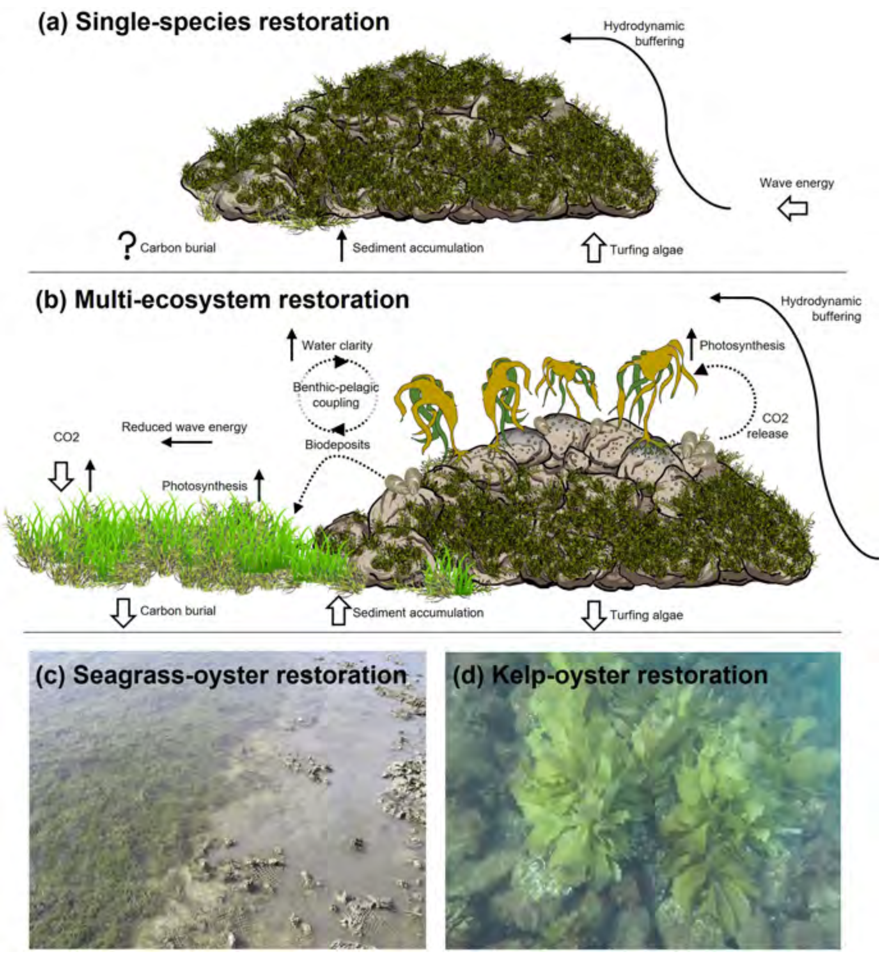
Bridging Land and Seascape Restoration for Ecoscape Recovery

Integrated multi-habitat / land-sea approaches to ecosystem restoration (for example across seagrass, saltmarsh, oyster reef and adjacent terrestrial habitats) to establish a widely applicable foundation for scalable approaches

Shifting from the current predominant focus on single habitat restoration towards “ecoscape restoration”

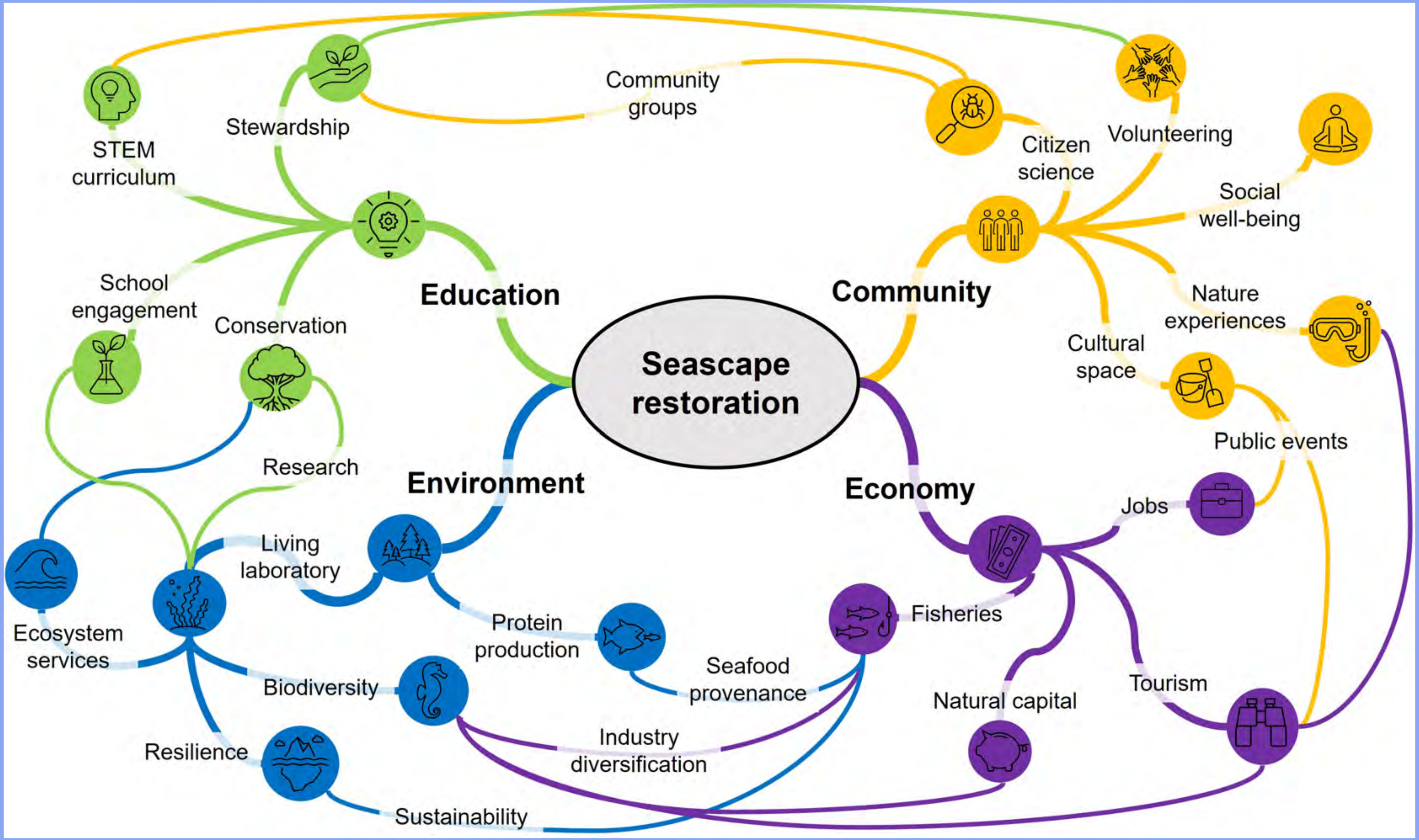
Upcoming collection in NATURE:
https://www.nature.com/collections/ebbjagefif

Examples of multi-habitat restoration in practice



Simultaneous restoration of:

- constructed oyster reefs that buffer hydrodynamics and stabilise sediments to promote seagrass recovery
- kelp transplants atop constructed reefs that maintain substrata free of turfing algae to facilitate understory oyster recruitment



McAfee et al. 2022

Mainstream NbS:

- into a wide range of activities (e.g. construction/infrastructure), sectors (e.g. the private sector), policies, development cooperation, etc.
- Examples: public-private partnerships, concessions, nature conservation agreements, standards, or public procurement law
- Twin crises: The complex interrelations between climate change and (marine) biodiversity loss) need to be communicated clearly to a wide audience.
- In financing instruments: should be designed and restructured to always take both climate change mitigation and biodiversity conservation into account.

Qi et al., 2022, Lo et al. 2022; Nesshöver et al., 2017, Tzoulas et al., 2021

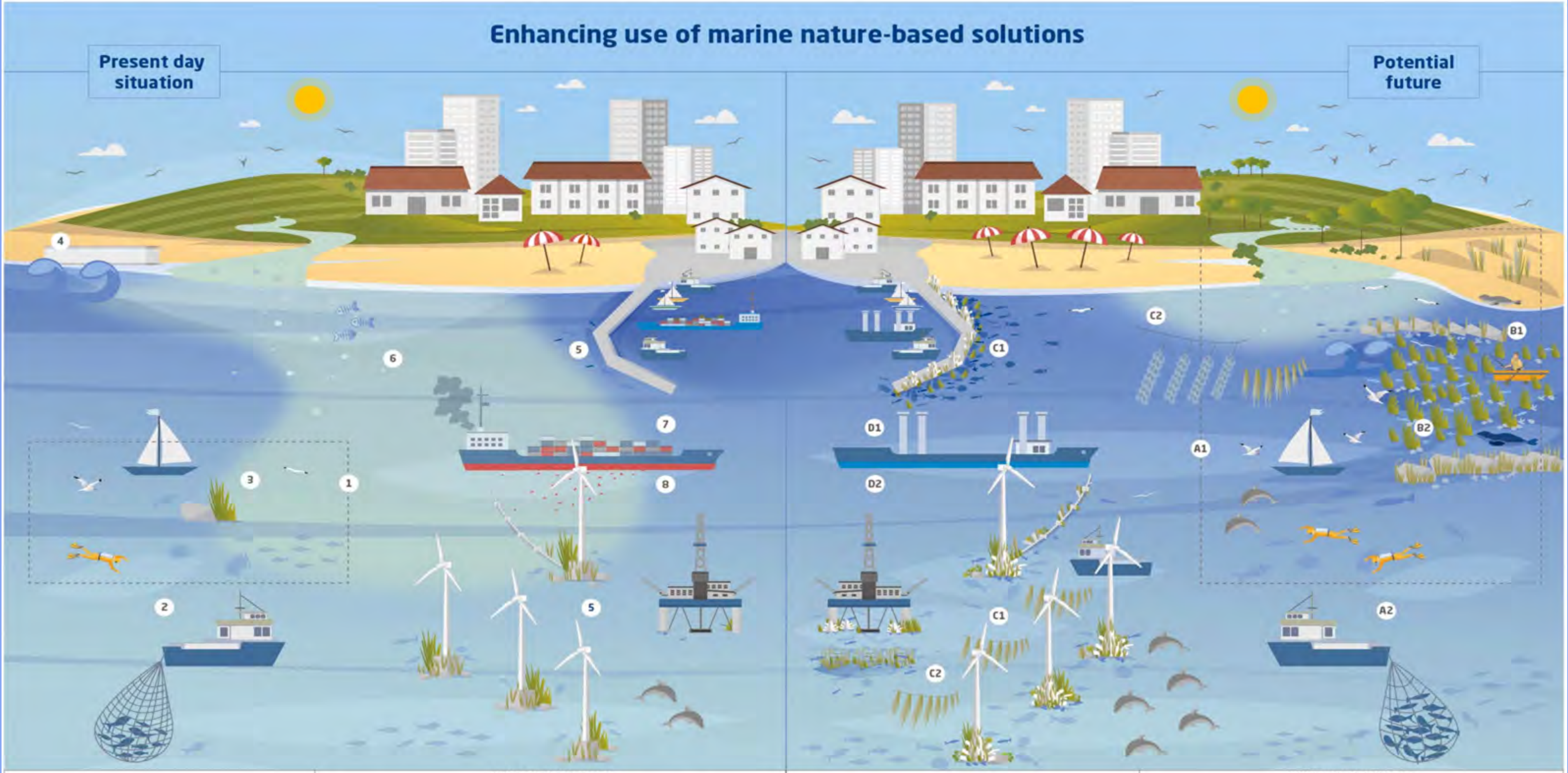
Bayraktarov et al. 2015

Upscaling

Part II Outlook

What to do next?

- Adapt NBS to local conditions and needs (from society and city perspectives)
- Foster an integrated NBS planning
- Explore and deploy new governance approaches from the local to regional scales
- Shift mindsets from silo thinking towards more integrated decision-making and planning
- Aknowledge weaknesses of the NbS concept and continue working towards its improvement



Present day situation		Climate change mitigation and adaption	Disaster risk	Economic and social development	Human health	Food security	Water security	Environmental degradation and biodiversity loss
		IUCN's societal challenges						
1	Small marine protected areas	●			●			●
2	Industrial fishing using non-selective gears					●		
3	Small patches of seagrass/seaweed/shellfish beds							●
4	Coastline protection using concrete infrastructure	●	●					
5	Coastal and offshore infrastructures	●	●	●				
6	Eutrophic waters							
7	Cargo ship using bunker oil			●				
8	Loss of toxic antifouling paint from ships							

Anthropogenic activities both on land and at sea impacts the health of marine ecosystems and their capacity for ecosystem service provisioning. Presently some activities resemble known types of nature-based solutions, yet deployment is scarse and at small scale, with many untapped potentials remaining.

Potential marine nature-based solutions		Climate change mitigation and adaption	Disaster risk	Economic and social development	Human health	Food security	Water security	Environmental degradation and biodiversity loss
		IUCN's societal challenges						
A1	Large marine protected areas	●		●	●	●		●
A2	Ecosystem approach to fisheries, using selective gear	●		●		●		●
B1	Seagrass/seaweed meadows and shellfish reef restoration	●	●	●		●		●
B2	Boulder reef/bed restoration to protect shoreline	●	●					●
C1	Greening of hard infrastructure, multipurpose artifical reefs and habitats	●	●	●		●		●
C2	Extractive aquaculture	●		●		●		●
D1	Cargo ships using primarily wind power	●			●		●	●
D2	Nature-based antifouling paint on ships				●		●	●

To deliver on EU and global targets, widespread deployment of nature-based solutions to multiple societal challenges will likely be needed. To support dialogues on the potential and risks of greenwashing, four types of NbS are suggested (modified from Eggermont et al 2015). Type A: NbS that improve the sustainable use and protection of natural marine ecosystems and their services; Type B: NbS that improve multi-functionality of managed marine ecosystems; Type C: NbS which provide novel, restored or deliberately designed artificial marine ecosystems; Type D: Nature inspired designs applied in marine environments which reduce environmental pressures.

Riisager-Simonsen et al. 2022

- Built and hybrid structures are key tools in the restoration tool chest

Rebuilding marine life

Substantial rebuilding of marine life by 2050 is feasible with coordinated efforts.

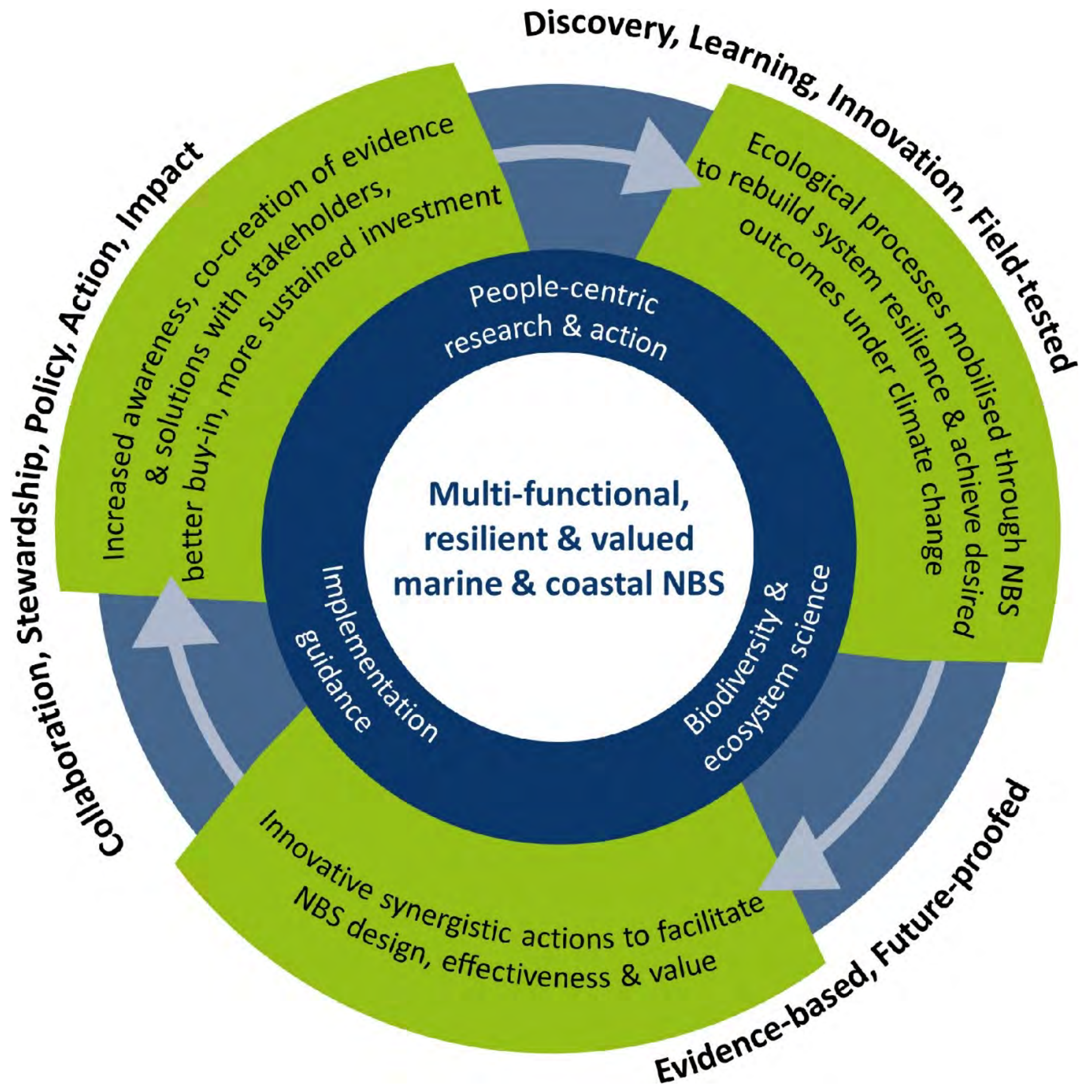
Requires mitigation of pressures, improved management, active restoration and substantial financial commitment.

Benefits include ecological, economic, and social gains.

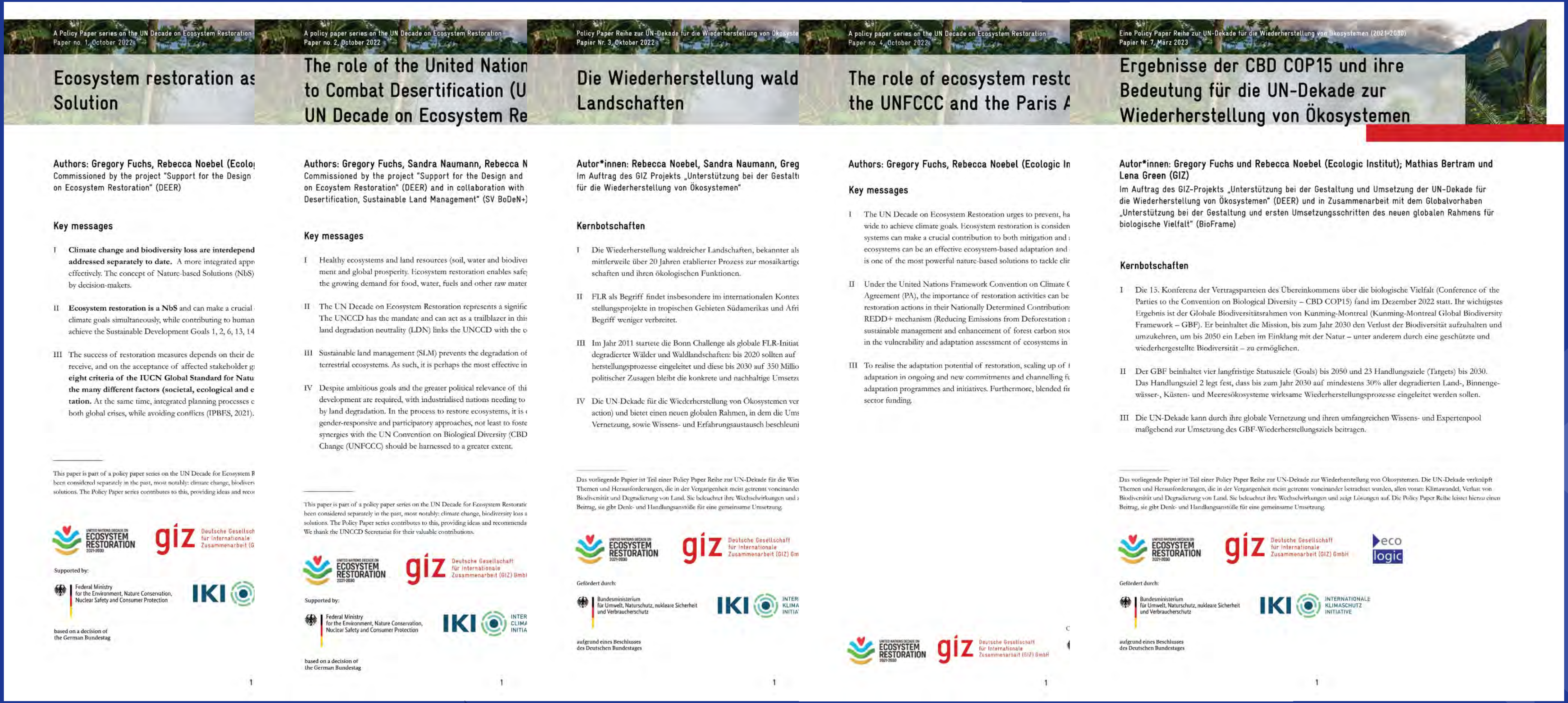
Research priorities

- Research can contribute to extending the scope of NbS and restoration approaches by developing science-based guidelines and decision tools to support decision-makers and other stakeholders in planning and implementation.

- A comprehensive understanding is needed of how integrated, cross-disciplinary governance approaches can be implemented successfully and on how an effective redesign of the socio-ecological system is interlocked with the current economic system.



Policy Brief series supporting the UN Decade for Restoration



https://www.ecologic.eu/18615

Open discussion, feedback, wrap-up

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Thanks! Any more Questions?

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