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FORESIGHT Brief

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Early Warning, Emerging Issues and Futures

Seagrasses, the forgotten ecosystems

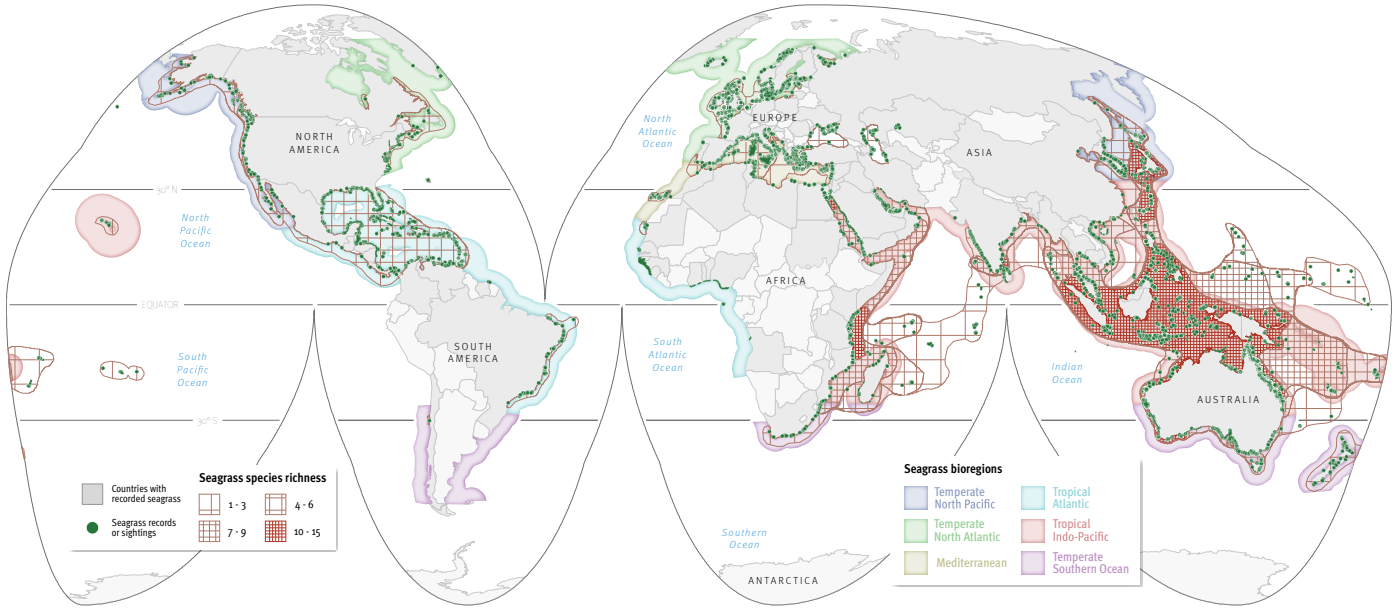
Background

The Foresight Briefs are published by the United Nations Environment Programme to highlight a hotspot of environmental change, feature an emerging science topic, or discuss a contemporary environmental issue. The public is provided with the opportunity to find out what is happening to their changing environment and the consequences of everyday choices, and to think about future directions for policy.

Introduction

Seagrasses are marine flowering plants, or *angiosperms*, comprising more than 70 species that form extensive meadows, highly productive and biologically rich habitats. They are among the most extensive of coastal ecosystems with a global areal cover of potentially over 300,000 km^2 distributed in 159 countries on six continents (UNEP 2020; Figure 1), except Antarctica (Green and Short 2003). Seagrasses occur in close proximity to other coastal and marine biotopes such as mangrove forests, coral reefs, kelp forests and tidal marshes, and are often interconnected and interdependent, providing valuable ecosystem services that greatly contribute to human well-being and the security of coastal communities. Although more than 1 billion people live within 100 km of seagrass meadows (Small and Nicholls 2003), seagrasses are often a forgotten ecosystem due to a lack of "charisma" and are therefore not as well protected as coral reefs and mangroves. Of the known distribution of seagrasses, only 26% occurs within marine protected areas, compared to 40% of warm-water coral reefs, 43% of mangroves, 42% of saltmarshes and 32% of cold-water corals (Table 1 and

Countries and areas with recorded seagrass



North America
Canada, United States of America

South America
Brazil, Chile, Colombia, Suriname, Venezuela

Central America and the Caribbean
Anguilla, Antiqua and Barbuda, Aruba, Bahama, Barbados, Belize, Bermuda, British Virgin Islands, Cayman Islands, Costa Rica, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica, Mexico, Montserrat, Nicaragua, Panama, Saint Barthelemy, Saint Kitts and Nevis, Saint Lucia, Saint martin, Saint Vincent and Grenadines, Trinidad and Tobago

Europe
Albania, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Greenland, Guernsey, Iceland, Ireland, Isle of Man, Italy, Jersey, Lithuania, Malta, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Spain, Sweden, Ukraine, United kingdom

Africa
Algeria, Angola, Benin, Comoros, Egypt, Eritrea, French Southern and Antarctic Lands, Ghana, Guinea, Guinea Bissau, Kenya, Libya, Madagascar, Mauritania, Mauritius, Mayotte, Morocco, Mozambique, Nigeria, Re-Union, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Togo, Tunisia, Tanzania

Asia
Azerbaijan, Bahrain, Bangladesh, Burma, British Indian Ocean Territory, Cambodia, China, Christmas Island, Cocos Islands, Hong Kong, India, Indonesia, Iran, Iraq, Israel, Japan, Jordan, Kazakhstan, Kuwait, Lebanon, Malaysia, Maldives, North Korea, Oman, Palau, Papua New Guinea, Philippines, Qatar, Russia, Saudi Arabia, Singapore, South Korea, Sri Lanka, Syria, Taiwan, Thailand, Turkey, Turkmenistan, United Arab Emirates, Vietnam, Yemen

Oceania
American Samoa, Australia, Fiji, French Polynesia, Guam, Kiribati, Marshal Islands, Martinique, Micronesia, New Caledonia, New Zealand, Norfolk Islands, Northern Mariana Islands, Samoa, Solomon Islands, Timor Leste, Tonga, Vanuatu

Source: Short, F.T. et al. (2007); United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) and Short, F.T. (2018).

Map produced by Levi Westerveld/GRID-Arendal (2019). Projection: Goode Homolosine

Figure 1. Global map of seagrass distribution, species richness and bioregions

Figure 2), making seagrasses among the least protected marine ecosystems (UNEP, 2020).

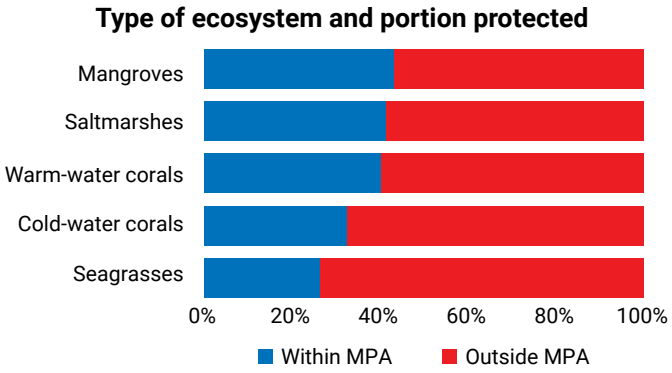


Figure 2. Percentage of different marine ecosystems within and outside Marine Protected Areas and portion protected

Credit: Benjamin Jones, Project Seagrass

Table 1. Global area recorded for different marine ecosystems and respective area protected

Type of ecosystem	Globally recorded area (km^2)	% within MPA
Seagrasses	324,248	26
Mangroves	152,233	43
Saltmarshes	54,661	42
Cold-water corals	18,993	32
Warm-water corals	150,045	40
Seagrass bioregion	**Recorded seagrass area (km^2)**	**% seagrass within MPAs**
Mediterranean	25,777	35
Temperate North Atlantic	3,031	77
Temperate North Pacific	1,134	70
Temperate Southern Oceans	19,609	48
Tropical Atlantic	108,887	32
Tropical Indo-Pacific	165,663	17

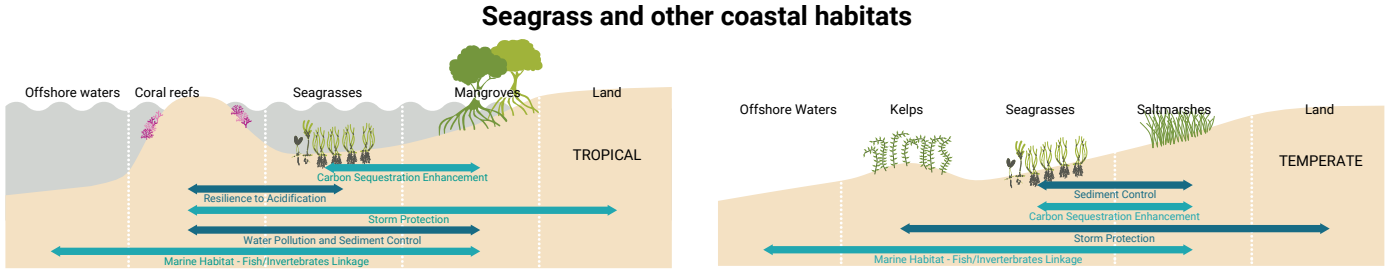


Figure 3. Connectivity of seagrass to other coastal habitats in tropical and temperate climates. *Source: GRID Arendal (2019)*

Why are seagrasses important

Seagrass meadows significantly support world fisheries production and global food security, providing valuable nursery habitat for over one fifth of the world's largest fisheries (Unsworth *et al.* 2019), as well as shelter and food for thousands of species including threatened charismatic species such as turtles, dugongs, seahorses and waterfowl.

There is also evidence that seagrass meadows provide powerful nature-based solutions to tackle climate change impacts. Seagrasses contribute to climate stabilization through sequestration and storage of carbon (Duarte *et al.* 2013) storing up to 18 per cent of the world's oceanic carbon (UNEP 2020), buffering ocean acidification and protecting coastlines by reducing wave energy.

Maintaining healthy seagrass ecosystems can therefore mitigate two of humankind's greatest challenges: feeding people and stabilizing the climate (Unsworth *et al.* 2019). In addition, seagrasses can improve water quality by filtering, cycling and storing nutrients and pollutants, with an economic value attributed to such services estimated at USD 34,000 $ha^{-1}yr^{-1}$, a figure greater than many terrestrial and marine habitats (Short *et al.* 2011).

A study by Lamb *et al.* 2017 found that where seagrass meadows are present, there is a 50% reduction in the relative abundance of potential bacterial pathogens capable of causing disease in humans and marine organisms. Seagrass ecosystems are interconnected with other ecosystems such as, kelp forests, salt marshes mangroves and coral reefs (Figure 3) through the direct transfer of carbon, nutrients and sediments; this connectivity is also important for the ontogenetic and foraging movements of marine fauna.

Recognizing the importance of seagrass ecosystems to biodiversity and human well-being (Figure 4) can help in conservation, better management and restoration of seagrass meadows. Conserving and restoring seagrass

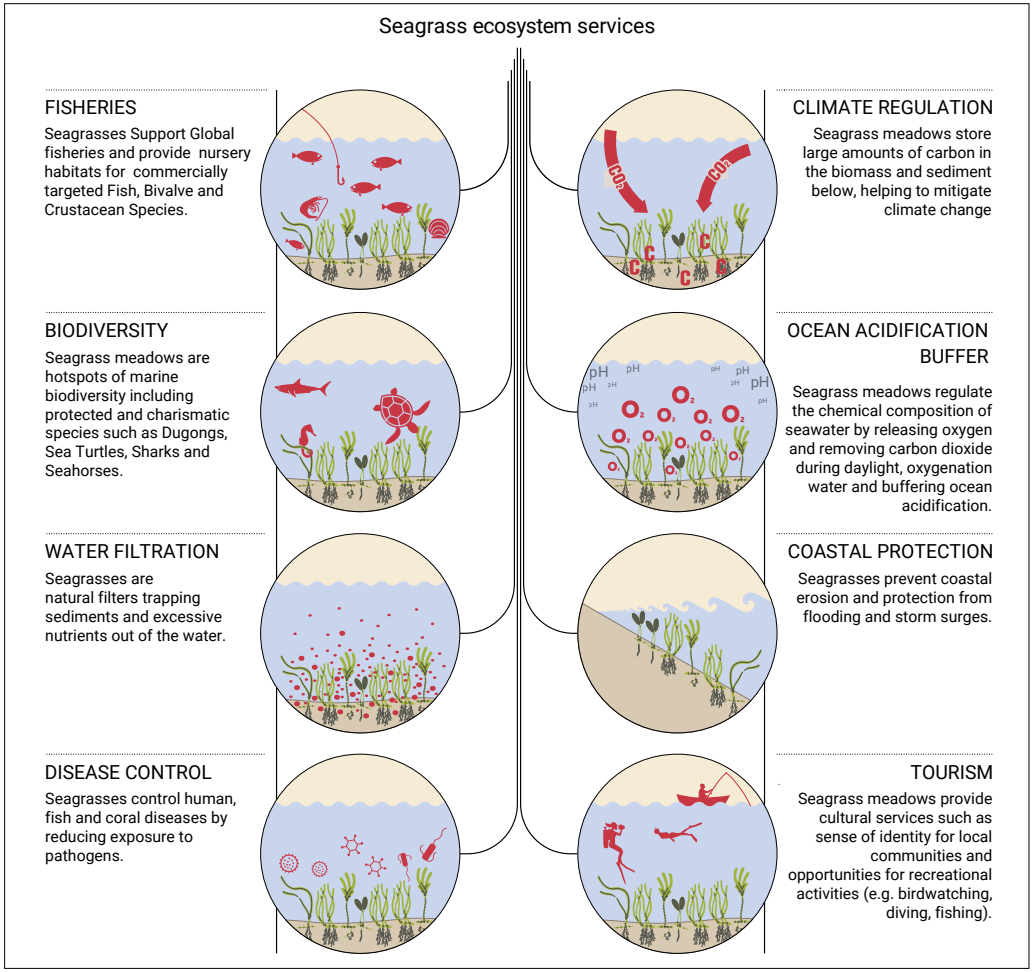


Figure 4. Seagrass ecosystem services

Source: GRID Arendal (2019)

Figure 5. Seagrasses' support to the Sustainable Development Goals and other international commitments.

Source: GRID Arendal (2019)

meadows can also help countries achieve 26 targets and indicators associated with 10 Sustainable Development Goals (SDGs) (Figure 5), and present an opportunity for countries to include these ecosystems into their nationally determined contributions (NDCs) to the Paris Agreement.

Multiple pressures from coastal development, nutrient run-off and climate change are collectively responsible for the degradation of seagrass meadows. The most up-to-date figures state that seagrasses have been declining globally since the 1930s and currently disappearing at 7% per year, faster than mangroves (1-3% per year) and saltmarshes (1-2% per year). Their extent has been decreased by over 10% per decade between 1970 and 2000 (IPBES 2019) and 22 of the world's 72 known seagrass species are in decline. Of the 72 seagrass species listed in the IUCN Red List of Threatened Species, three are Endangered (IUCN). Seagrass meadows are considered to be particularly vulnerable to climate change impacts with high risk of diversity loss and alterations in ecosystem structure and functioning. The IPCC special report on oceans and cryosphere (2019) ranks seagrasses among the top three ecosystems at high risk from climate change (Figure 6).

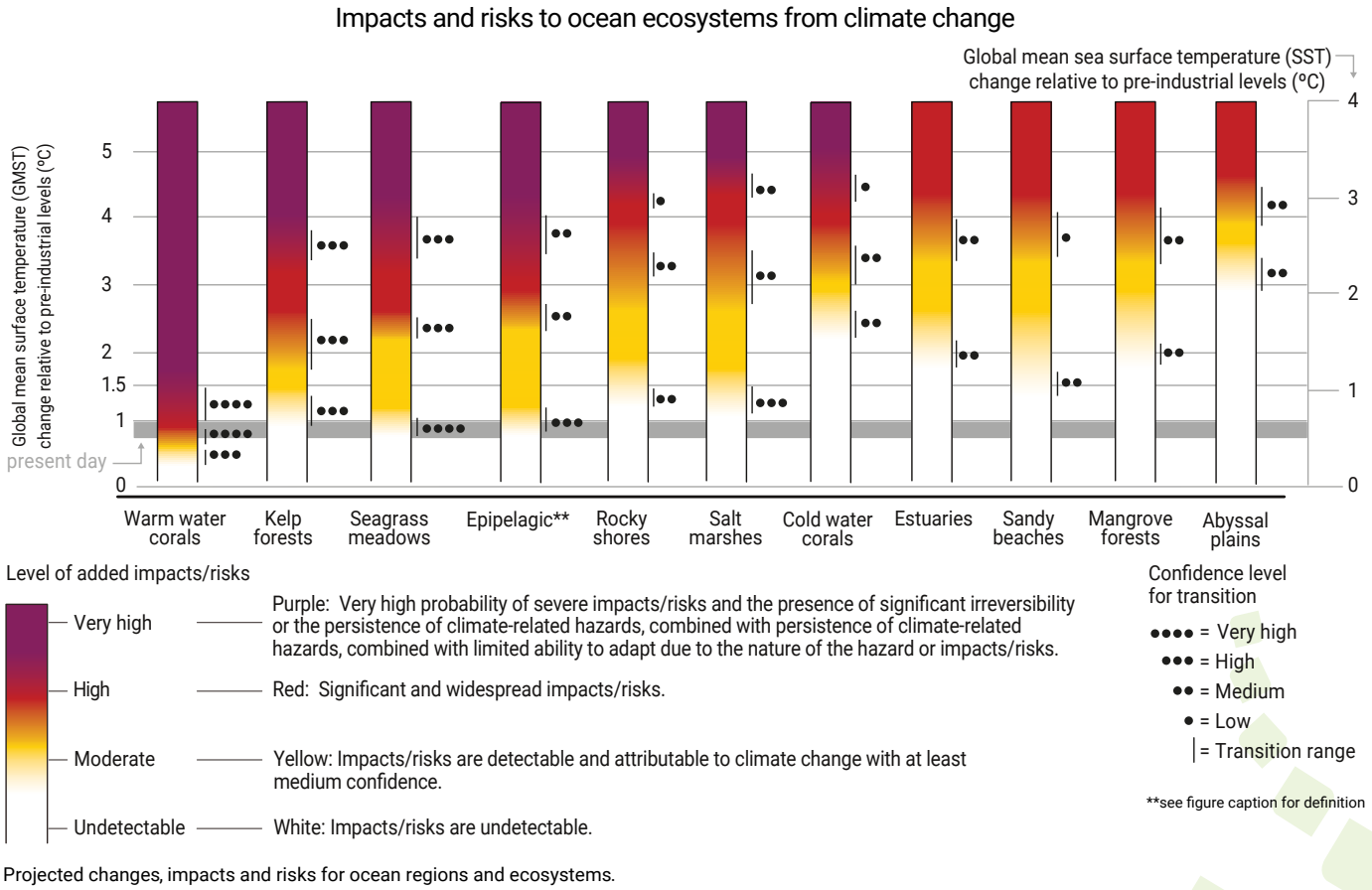


Figure 6: Impacts and risks to ocean ecosystems from climate change (Adopted from IPCC 2019: Summary for policymakers In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate).

Management options to address the cumulative drivers of seagrass degradation

Develop national action plans for seagrasses that include seagrass management action and targets for protection and health. These plans should implement temporally or spatially defined closures or no-take zones (to boost larval production and resilience and reduce pressures on degraded areas) and be connected to deliver on NDCs, Conservation of Biological Diversity targets and the SDGs and recognize connectivity with adjacent ecosystems.

Integrated coastal zone management or marine spatial plans with management measures for seagrasses. Seagrasses are connected with other habitats such as mangroves, coral reefs, kelp forests and tidal marshes. Connectivity is important in structuring biological populations and maintaining biodiversity and drives numerous ecological processes that benefit both seagrass and the connected habitats. Developing holistic management measures that are effective across the land-sea interface can reduce cumulative pressure facing seagrasses and address direct and indirect drivers of seagrass degradation. Management must take into account the factors necessary to strengthen seagrass ecosystem resilience, and support measures that enhance genetic diversity, species biological traits, ecosystem connectivity and continuous, non-fragmented habitat.

Seagrass ecosystem restoration involves the rehabilitation of degraded seagrass areas and can be effective in reversing biodiversity loss and recovering ecosystem services. Long-term studies have shown that seagrass restoration is effective in re-establishment of seagrass ecosystem services with high economic and environmental benefits. Restoration can be through implementation of management measures to improve water quality and seagrass health. For example in Oyster Harbour, Australia, eutrophication and siltation events caused around 80 per cent of seagrass cover to be lost in the early 1980s. Thanks to the initial planting efforts and continuous management of the catchment area and water quality monitoring, widescale recovery is apparent (Figure 7).

Mapping seagrass ecosystem services using indicators such as fisheries productivity, or carbon sequestered and stored is key to tracking changes over time and space. In data-poor areas, the priority should be mapping seagrass habitats which would then allow for services to be roughly mapped and estimated using meaningful indicators. Mapping and monitoring seagrass extent, cover and species composition is important to understanding these complex and dynamic ecosystems, highlighting areas of resilience and sensitivity, and predicting their response to climate change-induced pressures. Global-scale seagrass mapping is increasingly feasible by leveraging technological and data advances.

Oyster Harbour: Seagrass Restoration Network project

Aerial images of *Posidonia* seagrass transplant plots in Oyster harbour, Albany, Australia

Source: Aerial photographs showing details of the Posidonia seagrass transplant plots in Oyster harbour, Albany, over 3-6 years growth (October 2001) showing progress after a decade (January 2010) where separated plants in each plot had grown together to form a continuous dense meadow. [Photos: Geoff Bastyan]

Figure 7. Seagrass restoration project in Oyster Harbour, Australia.

Implement consistent remote sensing and in situ monitoring of the distribution and health of seagrass habitats. This approach can help to track the effectiveness of management measures, detecting inter-annual trends and supporting adaptive management and future planning. Monitoring can also play a role in informing sustainable development ambitions, tracking derived benefits associated with ecosystem services and reporting on national commitments in accordance with global targets.

Increase public awareness campaigns and education programmes to overcome the "charisma gap" while encouraging the use of traditional and local ecological knowledge in developing management strategies. In addition, strengthen the conservation and understanding of seagrass ecosystems through citizen science – using the general public as volunteers in data collection creates a much-needed workforce, while helping to link science, policy and practice in coastal natural resource management (Jones *et al.* 2018). Citizen science can improve conservation policies and outcomes by acquiring scientific knowledge creating an evidence base for policy making and engaging the public in decision-making (McKinley *et al.* 2017).

Sustainable Development, and the Ramsar convention on wetlands

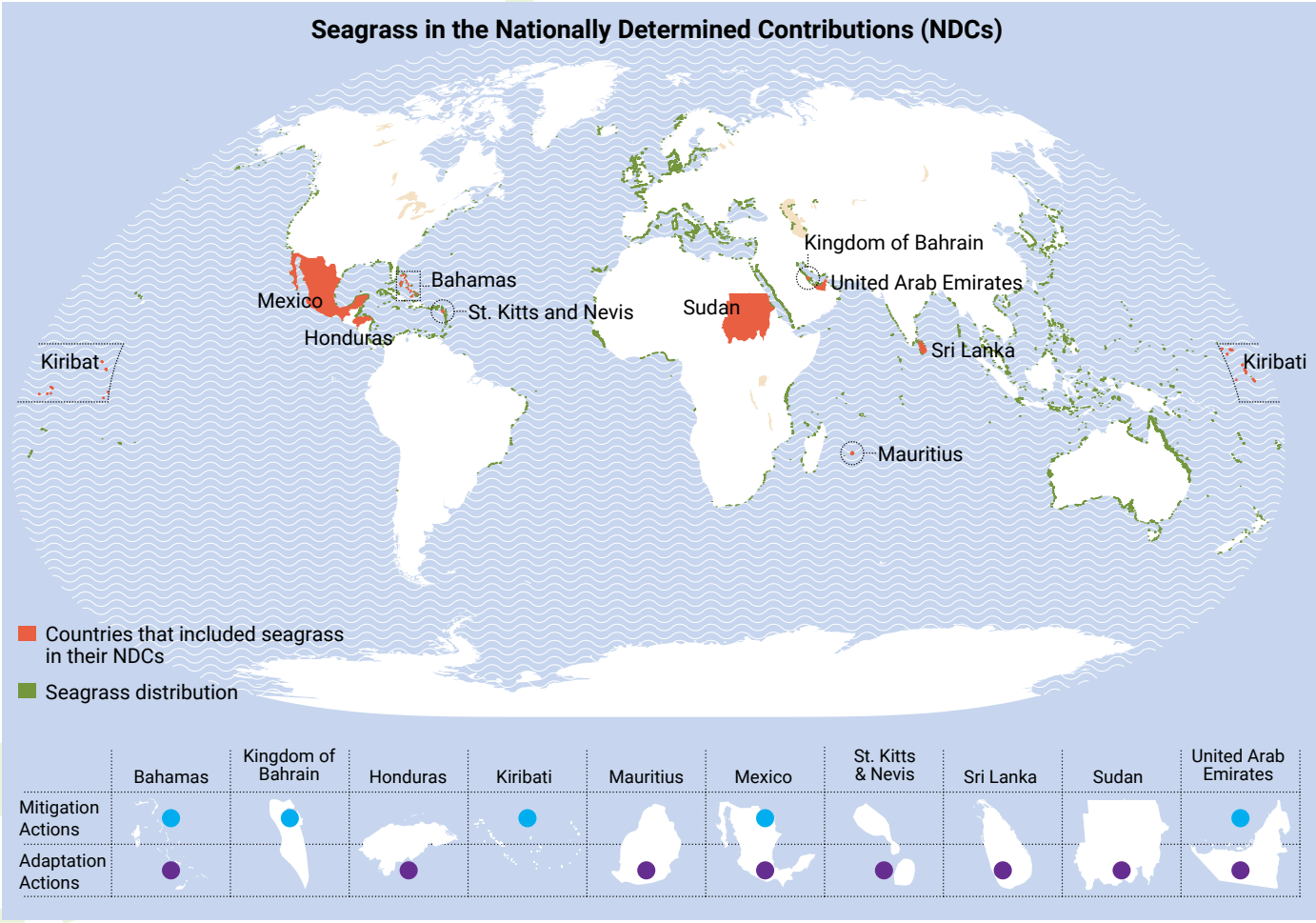


Figure 8. Map showing countries that include seagrass in their Nationally Determined Contributions. *Source: GRID-Arendal (2019); UNEP-WCMC (2018)*

Policy frameworks and management – despite their importance, seagrasses have often been a secondary consideration within policy and management measures. They are among the least protected coastal and marine ecosystems and this is an indication that they are not the focus of policy and management strategies. As of 2019, of the 159 countries that contain seagrasses, only 10 countries include an explicit reference to seagrasses in their NDCs (Figure 8), and only 1 country so far includes a measurable target that reference seagrass ecosystems. However, protecting and restoring seagrass ecosystems provides an opportunity for countries to achieve several biodiversity and sustainable development goals and targets set out by the global community in the coming decade. Some of the policy frameworks that can integrate seagrass include: the United Nations

Sustainable Development Goals (SDGs), the Convention on Biological Diversity and the post-2020 Biodiversity Framework, the Paris Agreement and NDCs, the Sendai Framework for Disaster Risk Reduction, the UN 2021-2030 Decade on Ecosystem Restoration and Decade on Ocean Science for Sustainable Development, and the Ramsar Convention on Wetlands.

Best practice examples

While seagrasses have not typically been the main focus of policies and management measures, there are examples of regional, national and local policy approaches that have led to proven benefits for seagrass ecosystems. A recent global review identified 20 best practice case studies covering five of the six seagrass bioregions and representing a range of potential pressures and governance structures (Griffiths *et al*. 2019). This review found that management frameworks require more cross-sectoral management approaches and integration across jurisdictions, aligning with the global move towards holistic, inclusive and sustainable ocean-based economies.

In the European Union, seagrasses have been explicitly referenced under Annex I of the European Union Habitats Directive which can lead to designation as "special areas of conservation". A recent study by de los Santos *et al.* (2019) showed that the rate of seagrass loss in European waters has slowed down for most species, and that there has been a positive reversal in the trend for fast-growing species.

In East Asian Seas, national action plans were developed for seagrasses in the south China sea and the Gulf of Thailand including the legislation needed to maintain nationally important habitat areas.

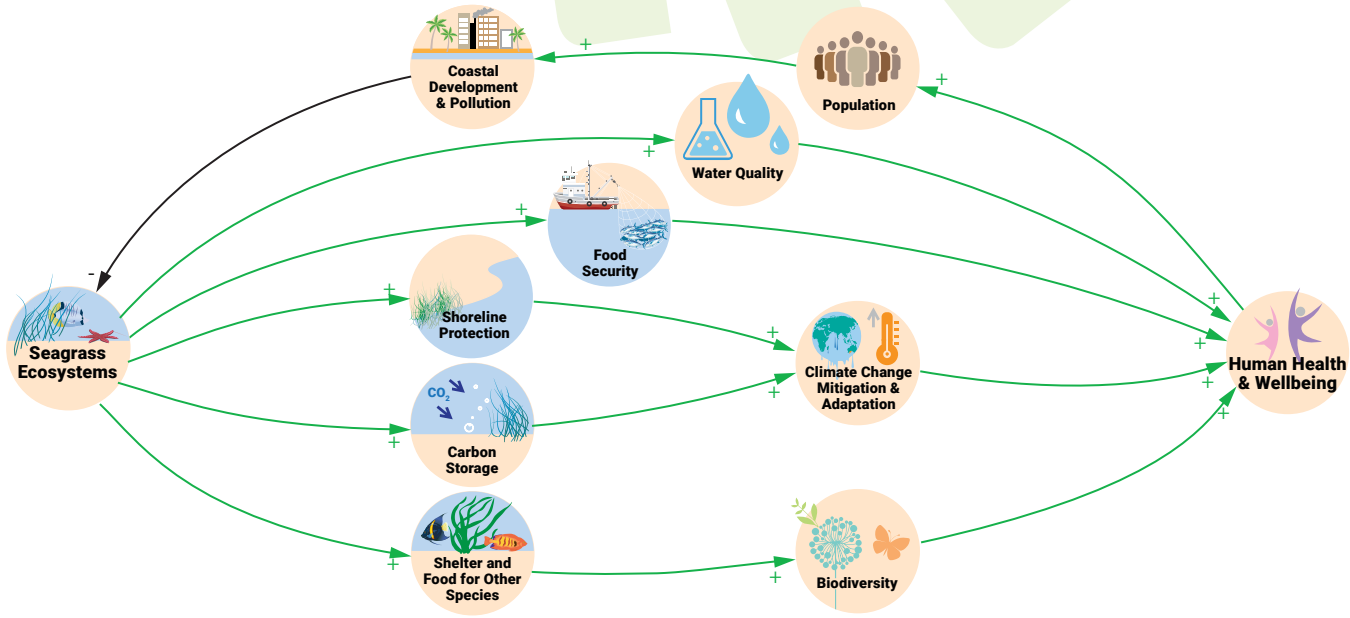
A Memorandum of Understanding on the Conservation and Management of Dugongs and their Habitats throughout their range was signed by 46 states across Africa, Asia and Oceania. The MOU aims to promote internationally coordinated actions to ensure the long-term survival of dugongs and their seagrass habitats.

Nationally, India - listed seagrass meadows as ecologically sensitive areas; New Zealand – inextricably linked seagrass management with the management of estuaries and coastal ecosystems; Australia – includes seagrass monitoring and reporting in its 2050 cumulative impact management policy programme and Indonesia has a national plan of action for dugongs and seagrasses.

In Tampa Bay, Florida, where seagrass area had declined by 46 per cent during 1950 and 1980 due to increase in nutrient loads, seagrass area increased markedly to approximately 1950s levels (>16,000 ha) following 90 per cent reduction in nitrogen loads within the bay, due to management of nutrient sources. In Timor-Leste, income from ecotourism project helps in seagrass mapping and locally managed marine areas (LMMA) management.

In Gazi Bay, Kenya, Mikoko Pamoja, an established community-based mangrove Payment for Ecosystem Services (PES) project has incorporated seagrass carbon into its activities and promote an integrated seascape approach to management, protecting 200 ha of seagrass in addition to 117 ha of mangroves for climate change mitigation and provision of ecosystem services to the community. In Koh Libong, the Thailand Greenhouse Gas Management Organization (TGO) supervise a project using carbon offset funds from a private company to conserve 1,000 ha of seagrass and later consider restoration.

A Systems Thinking Perspective



Population growth drives coastal development and diminishes Seagrass ecosystems. Policy interventions that protect Seagrass Ecosystems will help improve overall human health through reinforcing beneficial causal loops. (+) influence is in the Same direction, (-) influence is in the Opposite direction.

Other financial incentives – the protection and restoration of seagrass may be supported through existing financial mechanisms such as public funds, however their application to seagrass protection and restoration is currently limited and therefore other forms of incentives such as payments for ecosystem services (PES) show potential to supplement public funds.

Global Environment Facility

The Coral Reef Funding Landscape website (www.coralfunders.com) provides a useful resource for identifying investments in coral, seagrass and mangrove conservation. It hosts a data set of 314 projects, with the Global Environment Facility (GEF) Trust Fund as the leading source of finance. The GEF serves as a financial mechanism for many environmental conventions, helping developing countries to meet their obligations under the Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC), among others. Since 1994, this source has provided over $1.05 billion to more than 40 projects concerned with seagrass conservation and restoration.

Frequently commodified ecosystem services include carbon storage and sequestration, biodiversity (usually for tourism), landscape protection and hydrological services such as clean water and flood regulation. Of these, the largest and most well-developed market is for carbon. Since seagrass meadows provide all of these services, there is clearly more scope to apply PES to seagrass conservation and restoration.

Healthy seagrasses provide a source of opportunities to mitigate climate change, adapt to future changes, build resilience and offer multiple additional societal benefits. We need to act now to protect seagrasses by prioritising timely, ambitious and coordinated actions in the areas of conservation, sustainable management and restoration.

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Credit: Benjamin Jones, Project Seagrass

Recommended actions

International Policy

- Support the development of a policy expert group for seagrass for recommendations to the international community.
- Integrate seagrass into planning and implementation of the post-2020 global biodiversity framework.
- Include actions on seagrass ecosystems in plans for the United Nations Decade on Ecosystem Restoration and the United Nations Decade on Ocean Science for Sustainable Development.
- Recognize the value of seagrasses in Nationally Determined Contributions (NDCs) as a key component of climate change adaptation and mitigation.
- Recognize the value of protecting seagrasses for the SDGs, the 2030 Agenda for Sustainable Development and the other international policy targets.

Research

- Develop a comprehensive global map of seagrass health and distribution.
- Invest in understanding and quantifying the values of ecosystem goods and services that seagrass ecosystems provide.

Communication

- Raise awareness and communicate the economic and social importance of seagrasses, as well as the consequence of their loss.

Conservation action

- Develop national action plans for seagrass ecosystems.
- Engage stakeholders at all levels and stimulate partnerships to facilitate integration of seagrass conservation into planning and implementation phases.
- Designate more Marine Protected Areas or Locally Managed Marine Areas that include or focus on seagrass ecosystems.

Financing

- Increase national, bilateral and multilateral funding for the comprehensive actions required to conserve and sustainably manage seagrass ecosystems.
- Stimulate seagrass conservation and restoration by providing financial mechanisms and incentives.

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This Brief was prepared based on the findings of the report entitled 'Out of the Blue *The Value of Seagrasses to the Environment and to People*'.

Link to the report: https://www.unenvironment.org/resources/report/out-blue-value-seagrasses-environment-and-people

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Disclaimer

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