ACTIONABLE BLUE CARBON ECOSYSTEMS FOR CLIMATE MITIGATION AND ADAPTATION

POLICY BRIEF – NOVEMBER 2023

CONSERVATION INTERNATIONAL

the BLUE CARBON initiative

INTERNATIONAL BLUE CARBON INSTITUTE

Executive Summary

Coastal blue carbon ecosystems—which include **mangroves, seagrasses and tidal marshes**—are the most efficient natural carbon sinks on Earth on a per area basis. They cover an area equivalent to only 1.5% of terrestrial forests, but their ongoing degradation causes carbon emissions equivalent to 8.4% of the emissions from terrestrial deforestation.[1] In addition to their climate mitigation potential, coastal blue carbon ecosystems provide a suite of other benefits to coasts and communities, including biodiversity protection, food security, livelihoods and human wellbeing. In addition, they provide climate adaptation and resilience benefits—protecting millions of people globally from the impacts of coastal flooding, erosion, and storms.

This policy brief outlines the blue carbon ecosystems that are currently '**actionable**' for climate mitigation, based on the best available science and existing management practices. Ecosystems are considered 'actionable' if management of the ecosystem—such as conservation or restoration actions—results in a measurable and additional[2] reduction in greenhouse gas (GHG) emissions to, or increased GHG removals from, the ocean or atmosphere. Actionable blue carbon ecosystems for mitigation are recognized by the Intergovernmental Panel on Climate Change (IPCC) and can be included in national GHG inventories.

Additionally, this policy brief identifies the ecosystems that are '**emerging**' and may become actionable in the future (macroalgae, benthic sediments and mudflats), as well as ecosystems that do not currently have a mitigation pathway but offer other critical benefits for climate adaptation and resilience, biodiversity, and livelihoods (such as coral reefs, oyster reefs and marine fauna).

This brief does not consider climate mitigation options that move ecosystems further from their natural state and have possible negative impacts on human health and wellbeing, such as kelp afforestation and ocean fertilization. Non-ecosystem-based options for ocean carbon dioxide removal (CDR) are also not considered in this brief.

Countries can raise ambition for blue carbon habitat conservation and restoration through the **inclusion of blue carbon commitments in Nationally Determined Contributions (NDCs)**[3], national GHG inventories, National Adaptation Strategies (NAPs), National Biodiversity Strategies and Action Plans, and related national climate, biodiversity and sustainable development policies.

This policy brief is adapted from Howard et al. (2023), Lovelock and Duarte (2019), and an earlier version of this brief published in 2021.

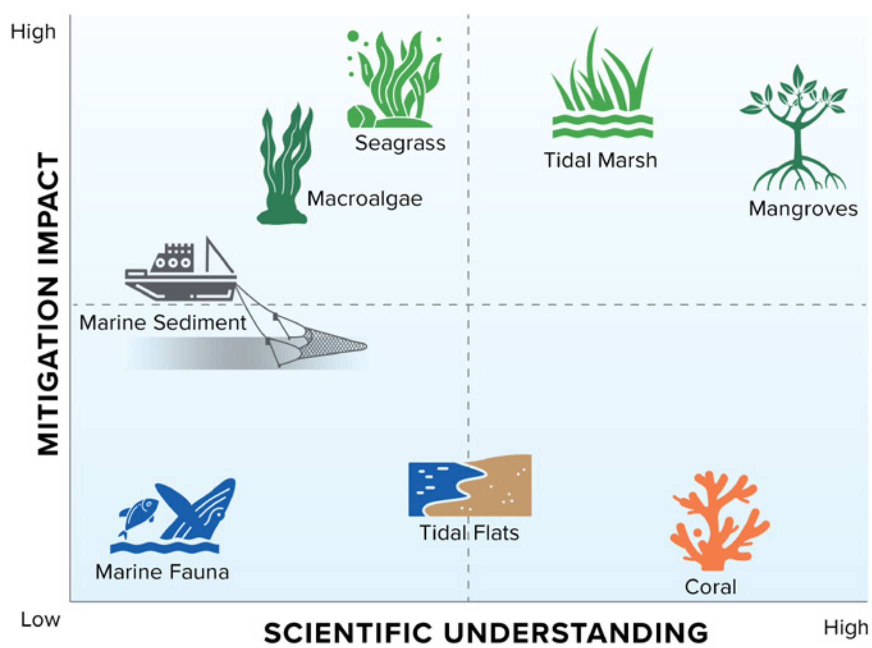

Figure 1: Among the actionable, emerging, and non-actionable ecosystems for climate mitigation, each habitat lies on a spectrum of scientific understanding informed by data availability, existing science that informs accounting methods such as uncertainty of carbon movement in the system, and mitigation impact informed by the global potential of these habitats to sequester and store carbon. This figure is adapted from Howard et al. (2023).

1 Griscom et. al. (2017).
2 As per Intergovernmental Panel on Climate Change (IPCC) guidelines.
3 Blue Carbon and Nationally Determined Contributions: Second Edition. The Blue Carbon Initiative (2023).

What Makes a Coastal or Marine Ecosystem 'Actionable' for Climate Mitigation

Factors that determine whether a coastal or marine habitat is actionable as a climate mitigation solution, and thus can be integrated into current climate mitigation policy, include: the **presence of high carbon stocks, evidence of long-term carbon storage**, and the **capacity for people to manage and effectively measure greenhouse gas emissions (GHG) and removals** resulting from changes to these ecosystems. In contrast, while some ocean and coastal ecosystems and organisms are essential components of the ocean carbon cycle, their climate mitigation capacity is not directly responsive to management actions and/or they do not sequester or store carbon long-term (100+ years). Additionally, many coastal ecosystems also provide significant climate adaptation and resilience benefits so even if they cannot be leveraged for their climate mitigation potential alone, they can be included in adaptation policies and actions.

Further scientific research and capacity building is needed to expand and strengthen the inclusion of blue carbon ecosystems in countries' climate mitigation and adaptation commitments and implementation plans. This work will include expanding the capacity of policymakers, governments and the private sector to assess, monitor and account for the climate mitigation and adaptation value of these ecosystems.

ACTIONABLE BLUE CARBON ECOSYSTEMS

Mangroves, **seagrasses** and **tidal marshes** meet the criteria as actionable in climate mitigation policy and are currently recognized for their climate mitigation value by the IPCC. Many countries have already included blue carbon ecosystems in their Nationally Determined Contributions (NDCs), national GHG inventories, National Biodiversity Strategies and Action Plans (NBSAPs) and other national climate mitigation, adaptation and biodiversity policies, but numerous opportunities remain to develop more ambitious commitments, and for implementation. The conservation and restoration of blue carbon ecosystems offer efficient pathways for GHG emissions avoidance and reduction, particularly for countries with large areas of coastal vegetation and high rates of loss. These ecosystems also provide valuable ecosystem services, including coastal protection and fisheries enhancement that are applicable to climate adaptation and resilience policies.

EMERGING BLUE CARBON ECOSYSTEMS

Ecosystems such as macroalgae (including kelp and seaweed farms) and marine sediment are known to sequester and store carbon, but the magnitude and long-term stability of this carbon value is currently under assessment. Significant scientific uncertainties remain for the pathways related to quantities of carbon sequestered and stored in these ecosystems, the movement and deposition of sequestered carbon, and emissions resulting from their disturbance. These carbon accounting uncertainties need to be reduced before incorporating these ecosystems into mitigation policy and accounting systems.

NON-ACTIONABLE ECOSYSTEMS FOR CLIMATE MITIGATION

For some ocean ecosystems, including marine fauna and calcifying organisms such as coral and oyster reefs, clear scientific evidence shows that they do not remove net carbon from the ocean or atmosphere and hence cannot be considered to contribute to climate mitigation. In other cases, the science is too uncertain to claim that human management can increase carbon sinks.[4] However, these ecosystems remain important for adaptation and resilience for coastal communities and biodiversity, among other benefits.

4 Howard et al, 2023.

Policy and Financing Tools to Enable and Accelerate Coastal Wetland Conservation and Restoration

Conservation and restoration actions in blue carbon habitats, if properly designed and executed, have the potential to contribute to **climate mitigation, adaptation** and **biodiversity** goals, generating a wide array of benefits that meet numerous objectives of the Paris Agreement, Convention on Biological Diversity, the Ramsar Convention on Wetlands, the Sustainable Development Goals, and other global targets.[5] Thus, these ecosystems can and should be included in climate mitigation and adaptation policies and actions wherever possible. Countries should work to include blue carbon activities in NDCs[6], in national GHG inventories, and raise ambition for the inclusion and/or increase of blue carbon ecosystems in NAPs and other national climate policies. To date, 61 countries have included the conservation or restoration of blue carbon ecosystems as mitigation measures in their new or updated NDCs.[7] Countries should also act to address the drivers of blue carbon ecosystem loss and degradation, and expand conservation and restoration of these ecosystems. Additionally, local communities and Indigenous peoples are essential for effective and successful conservation and restoration of blue carbon ecosystems and, thus, policies and actions must be inclusive and equitable.

To implement ambitious blue carbon commitments and associated national policies, robust financing is needed. Innovative financing models are essential for scaling mitigation actions through the management of blue carbon ecosystem, and market-based approaches are already under development.[8] As efforts to increase blue carbon financing through the voluntary carbon market expand and international compliance carbon markets emerge under article 6 of the Paris Agreement, it is vital that projects generate positive outcomes for people, nature and climate.

The High Quality Blue Carbon Principles and Guidance provides a framework for blue carbon credit purchasers, investors, suppliers, and project developers to responsibly and effectively leverage carbon markets with benefits to the climate, coasts and communities. Key to delivering high-quality outcomes in blue carbon projects is adherence to the five principles outlined in the guidance. Each of equal importance, they include the need to: **safeguard nature, empower people, employ the best information and carbon accounting principles, operate contextually and locally** and **mobilize high integrity capital**.[9] Alternative and innovative financing approaches are needed to provide long-term, sustainable resources for conservation of blue carbon ecosystems under a broad range of differing physical, ecological, social and political conditions. Conservation is more cost-effective and requires less overall investments than restoration so it should be prioritized whenever possible.

5 International policy framework framework for blue carbon ecosystems. IUCN and Conservation International (2023).

6 Blue Carbon and Nationally Determined Contributions: Second Edition. The Blue Carbon Initiative (2023).

7 Lecerf et al. (2023).

8 In 2021, the Vida Manglar project in Cispata, Colombia produced the first blue carbon credits sold on the voluntary market. Read more.

9 Meridian Institute et al. (2022).

Criteria for coastal and marine ecosystems to be considered actionable for climate mitigation

Coastal and marine ecosystems such as mangroves, seagrasses and salt marshes are considered actionable blue carbon ecosystems for climate mitigation and important to policy if the management of these ecosystems (e.g., conservation or restoration) results in a measurable reduction in GHG emissions to, or increased GHG removals from, the ocean or atmosphere. Actionable mitigation blue carbon ecosystems are recognized as such by the IPCC and can be included in national GHG inventories.

TABLE 1. Criteria to be considered actionable for climate mitigation

		Scale of GHG removals or emissions are significant	Net long-term storage of carbon	Anthropogenic impacts on the ecosystem are leading to GHG emissions	Management is practical/possible to maintain/ enhance C stocks and reduce GHG emissions	Included in IPCC GHG accounting guidelines[10]	Coastal Climate Resilience Value
Actionable Blue Carbon Ecosystems for Mitigation	Mangrove	YES	YES	YES	YES	YES	YES
	Tidal Marsh	YES	YES	YES	YES	YES	YES
	Seagrass	YES	YES	YES	YES	YES	YES
Emerging Blue Carbon Ecosystems	Macroalgae	?	?	YES	?	NO	YES
	Marine Sediment	?	YES	?	?	NO	NO
	Mud Flats	?	?	?	?	NO	YES
Other Ocean Ecosystems (Not Actionable)	Coral reef	NO	NO	NO	NO	NO	YES
	Oyster reefs	NO	NO	NO	NO	NO	YES
	Phytoplankton	YES	?	?	NO	NO	NO
	Marine Fauna (fish)	NO	NO	NO	NO	NO	NO

Source: Adapted from Lovelock & Duarte, 2019

10 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands.

TABLE 2. Actionable blue carbon ecosystems for climate mitigation.

ACTIONABLE			
	MANGROVES	TIDAL MARSHES	SEAGRASSES
11			
Carbon Storage	These blue carbon ecosystems sequester carbon through photosynthesis, which is stored in plant biomass and the soil below. Between 50–90% of the carbon is stored in the soils where it can remain for millennia.[12] These ecosystems have the highest rates of nature-based carbon sequestration per area: sequestration in mangroves is 168 gC m^{-2} yr^{-1}, tidal marshes is on average 242 gC m^{-2} yr^{-1}, and seagrasses is 83 gC m^{-2} yr^{-1}.[13]		

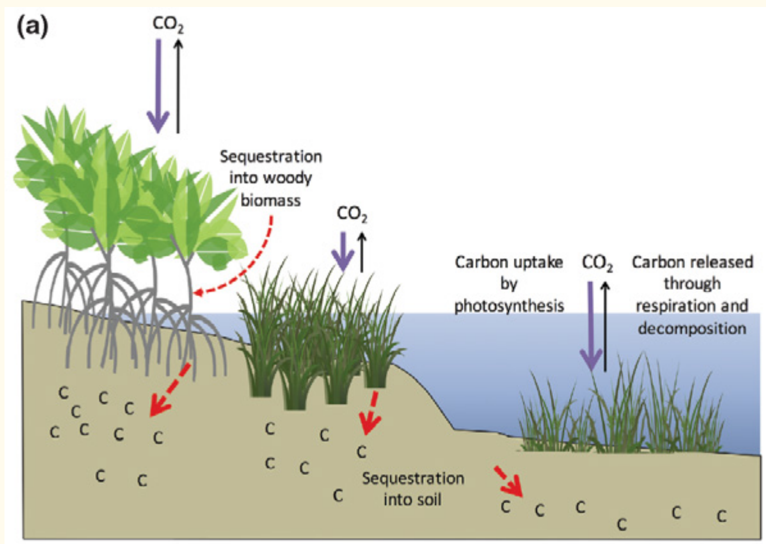

Figure 1: Image from Howard et. al, 2017

11 PHOTOS, LEFT TO RIGHT: Mangroves in Mozambique. © bartolomeo/Flickr Creative Commons; Salt marshes in Duxbury, Massachusetts, USA. © Conservation International/photo by Sarah Hoyt; Com, National Park, Timor Leste. © Paul Hilton for Conservation International

12 Howard et. al. (2017).

13 Taillardat et. al. (2018).

ACTIONABLE			
	MANGROVES	**TIDAL MARSHES**	**SEAGRASSES**
Drivers of Loss	Aquaculture, Agriculture, Coastal Development, Extreme Weather, Rapid Sea Level Rise	Agriculture, Coastal Development	Coastal Pollution, Erosion, Coastal Development, Substrate disturbance
Annual Emissions from anthropogenic impacts[14]	175.4-517.5 Tg CO_2	91.4-587.9 Tg CO_2	59.5-758.9 Tg CO_2
Management is practical/possible to maintain/enhance C stocks and reduce GHG emissions	Numerous approaches to carbon management including ecosystem conservation (such as marine protected areas, or MPAs), restoration, and hydrological rehabilitation (e.g., tidal restoration and (e.g. tidal restoration, and coastal rewetting).	Numerous approaches to carbon management including ecosystem conservation (such as MPAs), restoration, hydrological rehabilitation (e.g., tidal restoration and rewetting).	Numerous approaches to carbon management including ecosystem conservation (such as MPAs and mooring regulations), restoration, improving water quality through management of sediment and nutrient runoff.
Adaptation value	Coastal protection, ensuring food security (fisheries), erosion control, biodiversity protection. The dense roots of mangrove trees reduce the energy and height of waves and storm surges. A 100 m wide coastal strip of mangroves can reduce wave heights by up to two-thirds by absorbing wave energy.[15]	Coastal protection, ensuring food security (fisheries), erosion control, biodiversity protection. Salt marshes reduce wave height and energy reducing storm surges potentially providing flood abatement in low lying areas.	Food security (fisheries), erosion control, biodiversity protection. improved water quality.
Uncertainties	Carbon storage, sequestration, and emissions are scientifically well established. Scientific research is still needed to understand non-CO_2 GHG emissions, local and regional scale variations in carbon stocks, and in carbon sequestration rates under various restoration scenarios.	Carbon storage, sequestration, and emissions are scientifically well established. Scientific research is still needed to understand geographic distribution and change, non-CO_2 GHG emissions, particularly methane and nitrous oxide[16], local and regional scale variations in carbon stocks, and in carbon sequestration rates under various restoration scenarios.	Carbon storage, sequestration, and emissions are scientifically well established although with less certainty than mangroves and tidal marshes. Scientific research is still needed to understand geographic distribution and change, non-CO_2 GHG emissions, the role of carbonate in seagrass systems[17], seasonal, local and regional scale variations in carbon stocks, and in carbon sequestration rates under various restoration scenarios.

14 Howard et. al. (2023).

15 Jones HP, Nickel B, Srebotnjak T, Turner W, Gonzalez-Roglich M, Zavaleta E, et al. (2020) Global hotspots for coastal ecosystem-based adaptation. PLoS ONE 15(5): e0233005. https://doi.org/10.1371/journal.pone.0233005.

16 Howard et. al. (2023).

17 Howard et. al. (2023).

ACTIONABLE			
	MANGROVES	TIDAL MARSHES	SEAGRASSES
Mitigation Policy/ Finance Implementation	• 61 countries have included blue carbon ecosystems in their NDCs, with several countries specifically addressing the management of mangroves in NDCs • Mangroves are integrated into REDD+ in some countries • Mangroves are currently included in IPCC GHG accounting guidelines and a few countries have included mangroves within national GHG inventories • Carbon credits for conservation and restoration of mangroves available on voluntary markets	• 61 countries have included blue carbon ecosystems in their NDCs, with some countries specifically addressing the management measures of tidal marshes in NDCs • Tidal marshes are currently included in IPCC GHG accounting guidelines and some countries have included tidal marshes in their national GHG inventories • Methodologies for obtaining carbon credits exist for tidal marshes although to date no carbon credits have been generated	• 61 countries gave included blue carbon ecosystems in their NDCs, with some countries specifically addressing the management of seagrasses in NDCs • IPCC guidelines allow integration of seagrasses in national GHG inventories, although no countries have done so to date. • Methodologies for obtaining carbon credits exist for seagrasses although to date no carbon credits have been generated

TABLE 3. Emerging blue carbon ecosystems for climate mitigation.

	EMERGING		
	MACROALGAE (SEAWEED & KELP)	MARINE SEDIMENTS	COASTAL MUD FLATS
[18]			
Carbon Storage	Macroalgae, which include seaweed and kelp, are very effective at capturing carbon from the ocean through photosynthesis. They create plant material underwater, resulting in an estimated total of 173 million metric tons of carbon per year[19] worldwide. Unlike some other coastal habitats, macroalgae release most of the carbon they gather (more than 75%) back into the ocean. However, a portion of this released carbon (up to 10%) gets carried by ocean currents and ends up in the sediments on the continental shelf or in the deep sea. When this happens, the carbon is effectively removed from the carbon cycle, meaning it is no longer in the atmosphere. Macroalgae can also act as a source of carbon for other coastal habitats and can even export carbon to the open ocean. The amount of carbon that macroalgae effectively sequester depends on local ocean conditions. The best carbon capture rates happen in places with lots of kelp along rocky coastlines, especially when there are features like canyons, fjords, or narrow continental shelves nearby.	Marine sediments at the bottom of the ocean hold about 2322 billion metric tons, in the top 1 meter of depth. Nearly half of this carbon is found within areas controlled by countries (EEZs). This carbon has accumulated over thousands of years as organic matter sank to the ocean floor. If these sediments are left alone, the carbon remains there, but if they get disturbed, the carbon can be released into the ocean. Depending on the conditions in the ocean, it might end up at the ocean's surface and eventually be released into the air. However, uncertainty remains around what will happen to this carbon in terms of how it moves in the ocean, how it gets to the surface, how it interacts with the atmosphere, and how long this whole process might take before potentially causing emissions into the atmosphere.	Unvegetated mud flats are vast in extent, estimated to cover at least 127,921 km^2 globally.[20] They store sediments and carbon that originates from both marine and terrestrial sources over time. Unvegetated mudflats store approximately 16.6 million metric tons of carbon annually.[21] Research is emerging as to the magnitude and dynamics of carbon in mudflats. However, uncertainties remain as to the permanence of carbon held in mudflat sediments.

18 PHOTOS, LEFT TO RIGHT: Monterey, California, United States. © Keith A. Ellenbogen; A Queen Conch on white sand sea floor. Exuma Cays Land and Sea Park, Bahamas. © Jeff Yonover; The Wadden Sea in Schobüll in Germany. © manfredxy

19 Howard et al. (2023).

20 Murray et al. (2019).

21 Howard et al. (2023).

EMERGING			
	MACROALGAE (SEAWEED & KELP)	**MARINE SEDIMENTS**	**COASTAL MUD FLATS**
Drivers of Loss	Ocean warming and acidification, coastal pollution, coastal development.	Deep-sea trawling (fisheries), deep sea mining.	Reclamation and land-conversion for coastal development, changes in hydrology and sediment input, colonization by invasive species, coastal erosion, and sea-level rise.
Annual Emissions from anthropogenic impacts	36.7 TgCO2 (kelp)	Unknown	40.7-145.7 TgCO2
Management is practical/possible to maintain/enhance C stocks and reduce GHG emissions	Conservation and restoration of macroalgae is possible if the drivers of loss can be addressed including water quality management and other approaches. If increasing water temperatures are the dominant driver of loss, restoration may not be possible. Conservation of the long-term carbon stores generated by macroalgae requires managing the integrity of the continental shelf and deep-sea locations where macroalgae carbon accumulates, which may be far from production sites.	Marine sediment carbon can be maintained by reducing bottom trawling and deep sea mining in areas of high marine sediment carbon through managing fishing fleets or implementing MPAs.	Ecosystem conservation (such as MPAs). Restoration of hydrology and sediment flows. Restoration might also be possible where mud flats have been converted to aquaculture or colonized by invasive species (*Spartina*), by restoring the historic hydrological regime.
Adaptation value	Coastal erosion control, food security (fisheries), reduced wave energy during extreme weather events.	Unknown	Coastal protection (wave attenuation)
Uncertainties	There are significant scientific uncertainties as to the quantity, location and permanence of carbon sequestered by macroalgae ecosystems and the factors driving variability. The potential to scale macroalgae farming as a globally relevant (and manageable) carbon sink currently has many significant environmental, political, and engineering uncertainties, and there are substantial carbon emissions associated with farming operations. Efforts to sink seaweed in the deep sea as a means of ocean carbon removal should be paused until both the potential climate mitigation value and ecological impacts have been established. Scientific research is needed to understand non-CO_2 GHG emissions and the role of carbonate in seaweed systems.	Significant uncertainties as to quantitative atmospheric impact of deep-sea trawling (i.e., how much of the disturbed marine sediment carbon reaches the ocean surface) and the geographical and temporal variation in these emissions. Physical and biological factors driving variation in potential atmospheric emissions have not been well defined.	Impacts of reclamation and land conversion on emissions are unknown. Uncertainties in the rates of sequestration and permanence of carbon held in mudflat sediments.

EMERGING			
	MACROALGAE (SEAWEED & KELP)	MARINE SEDIMENTS	COASTAL MUD FLATS
Mitigation Policy/ Finance Implementation	Nine countries have addressed conservation or restoration of “other” coastal ecosystems in their NDCs, which includes algae, soft bottom habitats and kelp forests.[22] Some countries have indicated an interest in including wild macroalgae conservation and/or macroalgae farming for mitigation in their NDCs. We do not have easy and reliable ways to measure how much carbon is stored by seaweed and kelp ecosystems. These ecosystems are always changing, and we do not have good methods to track how carbon moves and gets buried in them. Also, when it comes to policies to reduce carbon emissions, we need to consider that wild and cultivated seaweed systems are very different in terms of their size, challenges, and how much carbon they capture. So, we have to treat them differently in these policies.[23] Robust methodologies for carbon credits are not available. Significant science is needed before such methodologies are viable.	Currently not included in mitigation policy or financing mechanisms.	Currently not included in mitigation policy or financing mechanisms.

22 Lecerf et al. (2023).
23 Howard et. al (2023).

TABLE 4. Other coastal and marine ecosystems, non-actionable for climate mitigation

	PHYTOPLANKTON	CALCIFYING ORGANISMS (CORAL REEFS, OYSTER REEFS)	MARINE FAUNA (FISH)
[24]			
Carbon Storage	The estimated amount of phytoplankton carbon in the oceans is 0.5–2.4 billion Mg C per year.[25] The size of the global phytoplankton carbon pool is relatively stable. Most phytoplankton are short lived and thus, carbon remains stored in their biomass only for hours to weeks. However, a small fraction of carbon in phytoplankton (0.1% or 0.5–2.4 million Mg C yr^{-1}) will sink and eventually become sequestered long-term in seafloor sediments.	Habitats dominated by calcifying organisms do not contribute to GHG mitigation, as the process of calcification results in a net release of CO_2. Thus healthy calcifying ecosystems are a net source of CO_2. Coral reefs and oyster reefs reduce coastal erosion and may indirectly contribute to carbon sequestration by coastal wetlands. The exact mechanisms, pathways and magnitude of this contribution is unknown.	Rather than removing atmospheric carbon directly, fish, whales and other marine fauna accumulate carbon in their biomass. This carbon is later released back into the ocean through respiration and defecation. Most fish feces are rapidly consumed by bacteria, ultimately greatly limiting the carbon reaching the deep ocean. While increases in fish and macro fauna populations, and hence fish biomass, will result in increases in the fish biomass carbon pool, this change will likely not result in any additional total ocean carbon sequestration as the carbon in the system is ultimately limited by phytoplankton primary productivity.
Drivers of Loss	Changing ocean temperatures and acidification, ocean circulation patterns.	Ocean warming, ocean acidification, coastal development, coastal pollution, overfishing	Overfishing, coastal development, ocean warming, human disturbance
Annual Emissions from anthropogenic impacts	None	None	Unknown

24 PHOTOS, LEFT TO RIGHT: © Ilya Sviridenko; Atauro Island, Timor Leste. © Paul Hilton for Conservation International; A school of Yellowstripe Scads in tight formation Shot in Raja Ampat Islands, Airborek Jetty, Dampier Strait, West Papua Province, Indonesia. © Jeff Yonover

25 Howard et al. (2017).

	PHYTOPLANKTON	CALCIFYING ORGANISMS (CORAL REEFS, OYSTER REEFS)	MARINE FAUNA (FISH)
Management is practical/possible to maintain/enhance C stocks and reduce GHG emissions	Although they represent a significant carbon pool globally, phytoplankton are not practical for climate change solutions because we cannot control their carbon capturing potential naturally. While adding iron to the ocean to make phytoplankton grow has been suggested as a potential solution, this idea is not widely accepted because it is uncertain whether this captured carbon would go deep into the ocean. Plus, there are potential risks and detrimental impacts to the ocean at large that could happen as a result.	None	None
Adaptation value	None	Coastal protection from storms. Sediment and erosion control. Food Security. Oyster reefs help improve water quality impacted by anthropogenic nutrient addition. Coral reefs buffer wave energy, in some cases up to 97%. They can significantly reduce erosion and cut flood damage costs by 50% annually.[26]	None
Uncertainties			The significance of fish and other marine fauna in increasing the amount of carbon transferred to the deep sea is not well established.
Mitigation Policy/ Finance Implementation	Not eligible for existing policy and finance applications.	14 countries have added acknowledgement of ocean changes in their NDCs, including acidification and coral bleaching.[27] A number of countries have included reef management and conservation as adaptation actions within NDCs.	59 countries have included climate-ready management of fisheries and aquaculture, and/or small-scale, artisanal fisheries as adaptation elements of their NDCs.[28]

26 Jones HP, Nickel B, Srebotnjak T, Turner W, Gonzalez-Roglich M, Zavaleta E, et al. (2020) Global hotspots for coastal ecosystem-based adaptation. PLoS ONE 15(5): e0233005. https://doi.org/10.1371/journal.pone.0233005.
27 Lecerf et al. (2023).
28 Lecerf et al. (2023).

Resources for Including Blue Carbon Habitats in Climate Mitigation and Adaptation Policy

Incorporating Blue Carbon Ecosystems in National Greenhouse Gas Inventories:

2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands. Methodological Guidance on Lands with Wet and Drained Soils, and Constructed Wetlands for Wastewater Treatment

This supplement extends the content of the 2006 IPCC Guidelines by providing updated science based on recent advances, and also added inland organic soils and wetlands on mineral soils, coastal wetlands including mangrove forests, tidal marshes and seagrass meadows and constructed wetlands for wastewater treatment.

Advice on Reporting Emissions and Removals from Management of Blue Carbon Ecosystems:

Coastal Wetlands in National Greenhouse Gas Inventories: Advice on reporting emissions and removal from management of Blue Carbon ecosystems

This resource has been developed to provide practical advice on incorporating coastal wetland ecosystems into National Greenhouse Gas Inventories by linking UNFCCC decisions related to coastal wetlands with existing IPCC guidance. It also illustrates how countries can apply principles outlined in the document by using examples of national experience.

Guidance for including Blue Carbon in Countries' NDCs:

The Blue Carbon and Nationally Determined Contributions: Guidelines on Enhanced Action: Second Edition

Updated in 2023, this resource includes technical guidance and lessons learned on how to incorporate blue carbon in NDCs, enabling countries to harness the national mitigation and adaptation benefits of coastal ecosystems.

Assessment of Blue Carbon in NDCs:

Coastal Blue Carbon Ecosystems: Opportunities for Nationally Determined Contributions

An assessment of blue carbon inclusion in the first Nationally Determined Contributions (NDCs) – 151 countries referred to at least one blue carbon ecosystem and 71 countries referred to all three in their initial NDC.

Coastal and marine ecosystems as Nature-based Solutions in new or updated Nationally Determined Contributions

An analysis of the first NDC revision cycle, including a comparison with first NDCs. As of 1 October 2023, 97 out of 148 new or updated NDCs include coastal and marine nature-based solutions (NbS) as part of mitigation and/or adaptation strategies.

Global Mangrove Watch

The Global Mangrove Watch (GMW) is an online platform that provides remote sensing data and tools for global monitoring of mangroves, in scientific collaboration with Wetlands International, Aberystwyth University, soloEO, TNC, JAXA, NASA and a host of partners. The GMW represents a critical tool, based on the most accurate science, to support countries in the process of implementing, updating or revising their NDCs, and move towards ratcheting up national and collective ambition on the potential of blue carbon ecosystems for climate action.

Integrating Mangrove Ecosystems into NDCs

The Global Mangrove Watch (GMW) offers a critical resource to support the integration of mangrove commitments into NDC revisions that have local and national relevance—and in collectively ratcheting up ambition and action on mangrove and other blue carbon ecosystems.

Best practice guidelines for mangrove restoration

The Best Practice Guidelines for Mangrove Restoration brings together the latest accumulated local and scientific knowledge about mangrove restoration best-practices into one comprehensive resource. The aim is to align mangrove practitioners, NGOs, governments, scientists, industry, local communities, and funders around accepted best-practices for science-based and inclusive mangrove restoration.

Ocean-Based Climate Action in New and Updated Nationally Determined Contributions

This working paper analyzes how ocean-based climate actions are included in new and updated nationally determined contributions (NDCs) from island and coastal countries and what this means for implementation over the next five years. Based on an analysis of 106 new and updated NDCs, 77 (73 percent) include at least one target, policy, or measure aimed at ocean-based climate actions.

Advancing Oceans and Blue Carbon in the UN Climate Negotiations:

Unpacking the UNFCCC Global Stocktake for Ocean-Climate Action

This report provides an overview of the Global Stocktake and maps how the ocean and coastal ecosystems can be reflected.

Options for Strengthening Action on the Ocean and Coasts Under the UNFCCC

This paper summarizes the key entry points within existing UNFCCC processes and negotiations where management actions concerning coastal and marine ecosystems can play a productive role in climate action. The recommendations below focus primarily on opportunities for advancing coastal Nature-based Solutions (NbS) including blue carbon. This options paper does not cover all areas of opportunity within the ocean-climate nexus, including marine renewable energy, marine (green) shipping, and aquatic food.

Implementing Blue Carbon Credit Projects in Coastal Ecosystems:

Voluntary carbon market methodology for conservation and restoration activities in tidal wetland ecosystems – VM0007 REDD+ Methodology Framework (REDD+MF), v1.6

Verra recently produced this methodology for carbon crediting projects, including tidal wetland ecosystems defined as mangroves, tidal marshes, and seagrasses

High-Quality Blue Carbon Principles and Guidance

High Quality Blue Carbon Principles and Guidance have been developed by Meridian Institute in collaboration with The World Economic Forum (WEF) Friends of Ocean Action, Conservation International, Ocean Risk and Resilience Action Alliance (ORRAA), alesforce, and The Nature Conservancy. The objectives of these principles and guidance are to provide a consistent and accepted approach to ensuring that blue carbon projects and credits optimize outcomes for people, biodiversity, and the climate.

Article 6 Explainer

This paper offers straightforward guidance on what was decided at COP27 and dives into the complex implications of Article 6 for NDCs, nature and the VCM.

Incorporating Blue Carbon Ecosystems Across International Policy Processes:

International Policy Framework for Blue Carbon Ecosystems

This policy framework, developed by Conservation International and IUCN, provides an overview of the intersections and opportunities for blue carbon ecosystem conservation and restoration in the relevant international policy processes.

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