THE FIFTH INTERNATIONAL WORKSHOP ON THE ECONOMICS OF OCEAN ACIDIFICATION: SUMMARY FOR POLICY MAKERS

Bridging the Gap between Ocean Acidification Impacts and Economic Valuation

Monaco, 12-14 October 2021

Blue carbon and other marine biological processes as a solution to mitigate the ecological and socio-economic impacts of climate changes in the ocean

Photo HSH Albert II Prince of Monaco. © Gaëtan Luci, Palais Princier

On October 2021, 37 experts from 15 countries participated in the Fifth International Workshop on the Economic Impacts of Ocean Acidification held in Monaco. The participants focused on using marine biological processes to fight climate change.

The multidisciplinary workshop connected knowledge from scientific and social areas related to the concept of blue carbon in coastal, open-ocean and deep-sea ecosystems, for the quantification of climatic benefits at local and global scales.

This workshop considered the feasibility of leveraging a range of oceanic biological processes related to the carbon cycle. Experts focused not only on rooted coastal vegetation, but also on macroalgae including kelps as well as phytoplankton production and organisms such as whales and fish that export carbon. They assessed the potential contribution of these biological processes to climate change mitigation, and as a solution to the ecological and socio-economic impacts of climate change-related consequences in the ocean.

The ocean plays a key role in global climate regulation through uptake and storage of heat and carbon dioxide

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"Ocean acidification lies at the confluence of these three crises (Climate change, biodiversity loss and pollution). It draws attention to the effects of unsustainable human activities, as well as the way in which they affect our society, raising concerns such as food security and supply. And it makes us become aware of the economic consequences, already noticeable for many sectors".

HSH PRINCE ALBERT II OF MONACO

WHAT IS BLUE CARBON.... ?

The term “blue carbon” refers to the carbon captured in coastal and marine ecosystems. This includes coastal vegetated ecosystems, such as mangroves forests, salt marshes, and seagrass meadows as well as the open ocean from the surface to the deep-sea.

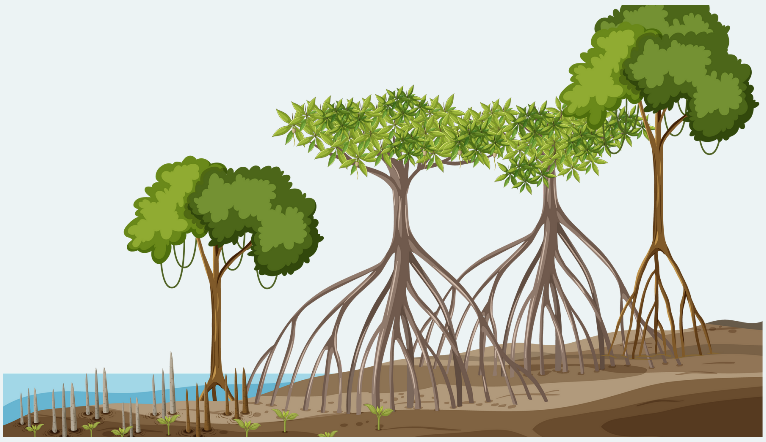
The carbon sequestration of ocean ecosystems is a crucial asset in order to limit global warming to 1,5° C above pre-industrial levels:

- in terms of volume: the Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC) (Intergovernmental Panel on Climate Change, 2019) states that over the past 200 years the ocean has taken up 500 Gigatons from the atmosphere out of 1300 Gigatons of CO_2 total anthropogenic emissions.

- in terms of efficiency: in the case of coastal vegetated ecosystems, the rates of carbon accumulation in sediments of salt marsh, mangrove, and seagrass habitats range between 18 and 1713 g C per m^2 per year (Mcleod et al. 2011). Rates of carbon accumulation in soils of terrestrial forests range from 0.7 to 55 g C per m^2 per year , depending on disturbance affecting these ecosystems (Mcleod et al. 2011).

- in terms of time: marine ecosystems can store carbon for millennia compared with terrestrial forests that only store carbon for decades or centuries. Damage to marine ecosystems releases ancient stored carbon, accelerating climate change.

For these reasons, the good management, protection, and restoration of blue carbon habitats should be central to local and global climate change mitigation policies.



NATURE-BASED SOLUTIONS...

Nature-based Solutions (NbS) are defined by the IUCN (2016) as “actions to protect, sustainably manage, and restore natural or modified ecosystems”, as strategies for simultaneously solving both socioeconomic and environmental problems.

They address societal challenges effectively and adaptively, alongside providing human well-being and biodiversity benefits. NbS are cost-effective and helping to build resilience.

Context

- Tropical and temperate coastal ecosystems are highly productive and form biologically rich habitats that play an important role in supplying ecosystem goods and services of great value to human well-being (Ayyam et al. 2019).

- Tropical and temperate coastal ecosystems include mangroves forests, tidal marshes, seagrass meadows, kelp beds, rocky coastlines, sandy, muddy, and cobble shores. These ecosystems sequester and store large quantities of carbon in both plant biomass and in sediments (Marcreadie et al. 2019).

Characteristics

- In addition to their ability to store carbon, these ecosystems provide numerous benefits and services to reduce the consequences of climate change (Ayyam et al. 2019), such as:
  - protecting coastlines from erosion.
  - buffering the impacts of hurricanes and storms.
  - forming natural flood defences.
  - regulating water quality.
  - providing habitats for marine life.
  - supporting food security for people.
  - creating job opportunities in fisheries, tourism.
  - bolstering spiritual values for surrounding communities.

Key figures

- Tropical and temperate coastal ecosystems are profoundly affected by humans. Development and urbanization of coastal areas due to increasing populations continue to destroy these habitats worldwide, with additional impacts from fisheries, aquaculture, and pollution (Gullström et al. 2021; Cohen et al. 1997).

- Coastal vegetated ecosystems have been and are still currently being lost or degraded worldwide. Up to 67% of mangrove forests, 29% of seagrass meadows and 50% of tidal salt marshes have already been lost (Himes-Cornell et al. 2018).

- Coastal vegetated habitats play a key role in the global sequestration of atmospheric carbon (Pendleton et al. 2012). For the top meter of sediment, carbon storage is approximately 259 Megagrams carbon per ha for tidal marshes, 407 Megagrams carbon per ha for mangroves, and 142 Megagrams carbon per ha for seagrass beds.

© photos: Belén Benitez -Med Sea & Galapagos Islands

OPEN WATER & DEEP SEA ECOSYSTEMS

Context

- "The open ocean provides more than 99% of living space on earth. It includes the epipelagic zone (or upper open ocean), the mesopelagic zone, and all the water column down to the sea floor (eg., bathyal, abyssal and hadal zones).
- The deep sea (defined here as the layer below the permanent thermocline where sunlight does not penetrate anymore) is vast and remote; it includes areas within and beyond national jurisdictions covering over 85% of the ocean floor. These ecosystems are teeming with life and support important and unique ecosystems.

Characteristics

- The ocean has absorbed the equivalent of 39% of industrial-age fossil carbon emissions, significantly modulating the rise of atmospheric CO_2 concentrations and the associated impacts on the climate (McKinley et al. 2020).
- Thus, carbon stocks down to 1 m depth in coastal sediments represent accumulation over hundreds to thousands of years, while a depth of 1 m in deep-sea sediments represent accumulation over 100s of 1000s to millions of years (Atwood et al. 2021).
- Carbon sequestration occurs in two ways that both have different impacts and occur at different scales:
    - Physical – the dissolution of CO_2 in the surface water, which is entrained in the global circulation to the deep layers (this is the cause of acidification).
    - Biological – the biological carbon pump, where carbon fixation by phytoplankton and its transfer to higher trophic communities is followed by deep sedimentation of the material produced by all living organisms, thereby sequestering carbon to the ocean interior for thousands of years or more.
- The open ocean and deep-sea ecosystems:
    - Are essential to the human-perturbed carbon cycle (Sweetman et al. 2017).
    - Are the largest stores of anthropogenic carbon after the atmosphere (Rogelj et al. 2018).
    - Play a crucial role in maintaining anthropogenic carbon in the Deep Ocean.

Key figures

- Since 1830, the open ocean is estimated to have absorbed around 500 Gigatons (Gt) of carbon. At today's market price of carbon, the value of this amount of carbon would be around $2 trillion.
- Most of the oceans remains to be explored. It harbours a tremendous biodiversity, even in highly extreme environments.
- Warming, deoxygenation and acidification affect biodiversity and the functions of life in the ocean, which modify the oceans capacity to absorb / sequester carbon (Levin and Le Bris, 2015).
- Threats and Emerging activities are reflected in the following:
    - Climate change-related pressures.
    - Warming and acidification.
    - High vulnerability to deoxygenation.
    - Projected reduction in carbon flux to depth reducing food availability to deep communities.
    - Deep-sea fishing.
    - Mining exploration and exploitation activities.
    - Offshore aquaculture.

© photo 1: NOAA Ocean Services website. The website caption reads, "A vampire squid... [+]

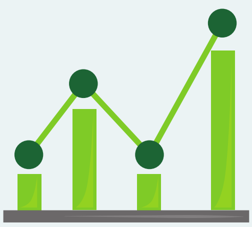
POLICY RECOMMENDATIONS

To preserve, restore and enhance blue carbon sinks

ECONOMICS & FINANCE

In order to better protect the ocean, there is a need to establish sustainable financial mechanisms. Without certain measures, there will be considerable economic risks given the importance of the ecosystem services provided by the ocean (with an increasing cost of no-action). In such context, it is recommended to:

- Subsidize blue carbon preservation projects through targeted use of public and philanthropic funding. Funding policies could include:
  - Give tax breaks for blue carbon contributions.
  - Implement carbon pricing, so that the prices of all goods produced to reflect the costs of blue carbon degradation.
  - Give subsidies for protection.
  - Implement fines for violations.
  - Implement accounting and sale of carbon offsets from the open ocean.
- Establish an Universal Ocean Wealth Fund for restoration, monitoring, and supporting scientific research and ocean literacy.
- Conduct inclusive and participatory cost-benefit analysis of restoration. The decision-making should incorporate management in the short, medium and long run.
- Assess locally the opportunity costs (such as local fishing rights, potential investment in infrastructure, nuclear facilities) for keeping or replenishing coastal wetlands.
- Adopt ambitious policies with long run horizons, involving multiple (including young) generations since micro-pricing and opportunity costs of protecting an ecosystem are short run issues.
- Monitor the open ocean is necessary to avoid damaging its absorptive capacity.
- Conduct research on the open ocean so as to better understand it as a regenerative economy, and therefore, to construct a Regenerative Ecosystem Services Shadow Gross domestic product (GDP) . Open waters constitute the 7th largest GDP globally.
- Provide liquidity and credit facilities such as green banking credit investments and funding for decarbonated investments.
- Reassess monetary policy in light of carbon conservation considerations.
- Avoid asset bubbles in nature, considering that putting synthetic universal carbon prices on natural resources can create asset bubbles.



POLICY RECOMMENDATIONS

To preserve, restore and enhance blue carbon sinks

GOVERNANCE & LAW

Governance of the ocean is a crucial issue in order to jointly tackle the common threats to blue carbon. This requires urgently a mobilization on the following points:

- Improve "good governance" for Nature-based Solutions (access to information, access to public participation and access to justice) at all the levels of governance in order to empower local communities and citizens to face climate change related societal challenges.
- Undertake national conservation efforts to ensure that blue carbon ecosystems continue to play their role as carbon sinks in the long term.
- Use community-based ecosystem management programs for an optimal use of available resources. Complement Marine Protected Areas (MPAs) with Marine Spatial Planning (MSP) strategies and implement sustainable fisheries and better stakeholder engagement and input.
- Consider by policy-makers carbon of autochthonous[2] origin in blue carbon ecosystems.
- Establish regulations that include parameters on carbon capture to reduce emissions.
- Make climate stability a long-term viable strategy.
- The open ocean and its deep sea are a "common heritage of humankind". Governance at the global level would ensure the interests of all countries in the long term (100 years or more) consistently with the common interests of all humanity.
- Make fisheries management tools take into account ecosystem-based approaches by changing the cap of fisheries, as well as carbon fluxes and storage.
- Improve policy and legal tools and instruments protecting deep-sea ecosystems to achieve the objectives of the United Nations Framework Convention on Climate Change (UNFCCC).
- Incorporate blue carbon commitments in Nationally Determined Contributions (NDCs).

[1] Carbon authoctonous: This type of carbon is produced and deposited in the same location. Plants remove carbon dioxide (CO_2) from the atmosphere/ocean through photosynthesis (primary production) and convert it for use by plant tissue (such as leaves, stems, roots/ rhizomes) to increase plant biomass (UICN, 2019).

POLICY RECOMMENDATIONS

To preserve, restore and enhance blue carbon sinks

GOVERNANCE & LAW

Governance of the ocean is a crucial issue in order to jointly tackle the common threats to blue carbon. This requires urgently a mobilization on the following points:

- Ensure relevant synergy between Locally Determined Contributions (LDCs) and the Nationally Determined Contributions (NDCs).
- Make Nature-based Solutions gain universal acceptance by including marginalized communities and indigenous populations.
- Better integrate climate law and biodiversity law at multi-regulatory level (international, regional, national, and local) to address problems of implementation.
- Explicitly incorporate, integrate, and coordinate blue carbon activities in existing regulatory frameworks to mitigate and adapt to climate change.
- Identify key human activities that contribute to protecting carbon stocks and improving carbon sequestration.
- Implement and coordinate better climate conventions with other legal and policy instruments of ocean and biodiversity governance to improve communities' livelihood and collective universal interests. For instance, an inventory of the type of ownership of coastal areas could be useful, including NGOs and privately held areas.
- Take into account in policy making that the complementary goals of climate stabilization and biodiversity (such as conservation) and meeting human needs are indispensable for sustainability.
- Monitor the open ocean and deep-sea floors in order to avoid damaging their absorptive capacity (carbon sequestration). Penalties should be applied, in case of damage due to human activity.
- Create a network of Marine Protected Areas (MPAs) involving local, regional, and international governments.
- Develop mechanisms within the UNFCCC that (i) incentivize preservation over restoration of blue carbon ecosystems and (ii) allow proactive conservation to be accounted for in Nationally Determined Contributions (NDCs).

POLICY RECOMMENDATIONS

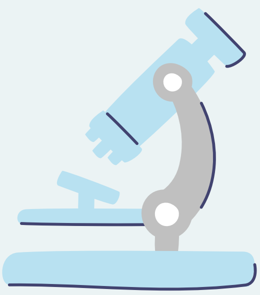
To preserve, restore and enhance blue carbon sinks

RESEARCH

We are only able to manage what we know, and in the case of the ocean a lot remains to be done in the fields of scientific research and ecosystem characterization and monitoring for a better understanding of blue carbon processes. It is therefore recommended to:

- Invest in research to understand changes and make projections for the future of the world's oceans.
- Take inventory/stock of coastal vegetated ecosystems to assess losses as these ecosystems migrate to higher latitudes with global warming.
- Conduct scientific research on blue carbon in both coastal and high sea contexts, to evaluate carbon sequestration and losses.
- Assess and minimize the potential impacts of bottom trawling on carbon stored in the seabed.

- Scale up funding for assessments and research on the importance and value of blue carbon ecosystems.
- Strengthen investment and financing for research projects on blue carbon ecosystems.
- Engage multiple generations and a diversity of people when assessing the value and the relationships of people with blue carbon ecosystems.
- Coordinate the different research and monitoring players in direct or indirect relation with blue carbon ecosystems to achieve the expected results.



Warming, deoxygenation and acidification affect biodiversity and life in the sea, thereby modifying the oceans' capacity to absorb and sequester carbon.

The longer we wait, the more we will slow down the ocean carbon absorption rate

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Blue carbon and other marine biological processes as a solution to mitigate the ecological and socio-economic impacts of climate changes in the ocean

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