



The International Blue Carbon Initiative

Increased conservation, restoration and sustainable management of coastal blue carbon ecosystems



<http://thebluecarboninitiative.org/>



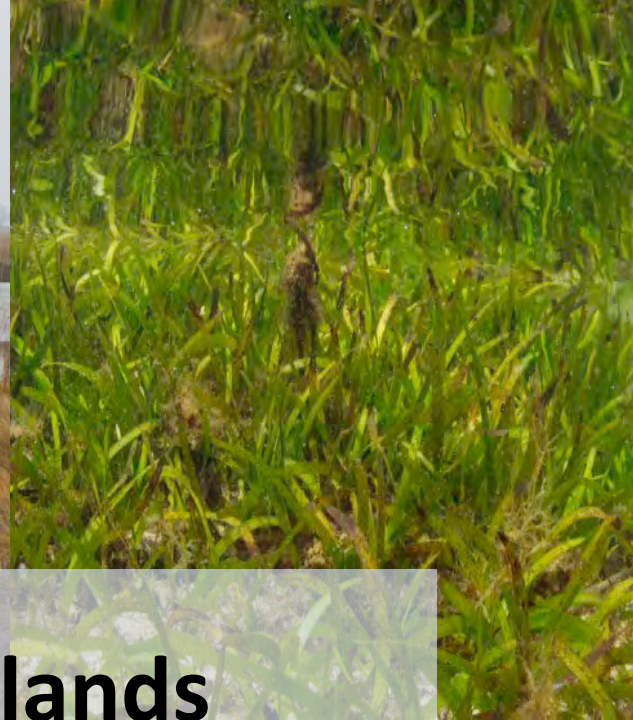
United Nations
Educational, Scientific and
Cultural Organization



Intergovernmental
Oceanographic
Commission

Dan Laffoley, Marine Vice Chair, IUCN World Commission on Protected Areas

(Illustrations – Dorothee Herr & Dan Laffoley)



Coastal (carbon) wetlands





The Management of Natural Coastal Carbon Sinks

A short summary

Edited by Dan Laffoley and Gabriel Grimsditch

November 2009

Introducing coastal marine carbon sink

Climate change is arguably one of the biggest issues facing humanity. World leaders now recognise that urgent and significant reductions in our emissions of greenhouse gases are needed if we are to avoid future dangerous climate change. Alongside such measures is an increasingly strong recognition that there is a need to properly manage particular habitats that act as critical natural carbon sinks.

The production of the report has been stimulated by an apparent lack of recognition and focus on coastal marine ecosystems. There is an urgent need to complement activities already well advanced on land to address the best practice management of terrestrial carbon sinks such as forests and peatland. This report is therefore timely as a number of Governments are now introducing legislation to tackle climate change and quantify carbon sinks. Interest in and actions to address the underlying causes of climate change are also growing—regulation of anthropogenic emissions of greenhouse gases into the atmosphere, avoiding deforestation, management and protection of other natural terrestrial carbon sinks, and the development of fiscal measures that place a value on carbon and therefore provide an economic incentive to reduce emissions.



From top left to bottom right: Mangroves, New Caledonia © Dan Laffoley; Photovizor; Inical sea star on Shikazo herpetical anemone, Tanga, Tanzania © Jerker Tanelander; Kelp forest at Lundy Island, UK © Beth Hirsch; Tidal saltmarsh, Cleeve Harbour, New Brunswick © Gail L. Chinara

It is important that such quantifications and processes work with the latest science and evidence.

To construct the report we asked leading scientists for their views on the carbon management potential of a number of coastal marine ecosystems: tidal salt marshes, mangroves, seagrass meadows, kelp forests and coral reefs. These ecosystems were

selected because of the initial belief that they should be good at sequestering carbon, and are located in situations where management actions could secure the carbon sinks. If evidence substantiated this claim then this could expand the range of global options for carbon management, unlocking new possibilities for financing and protecting the coastal marine environment.



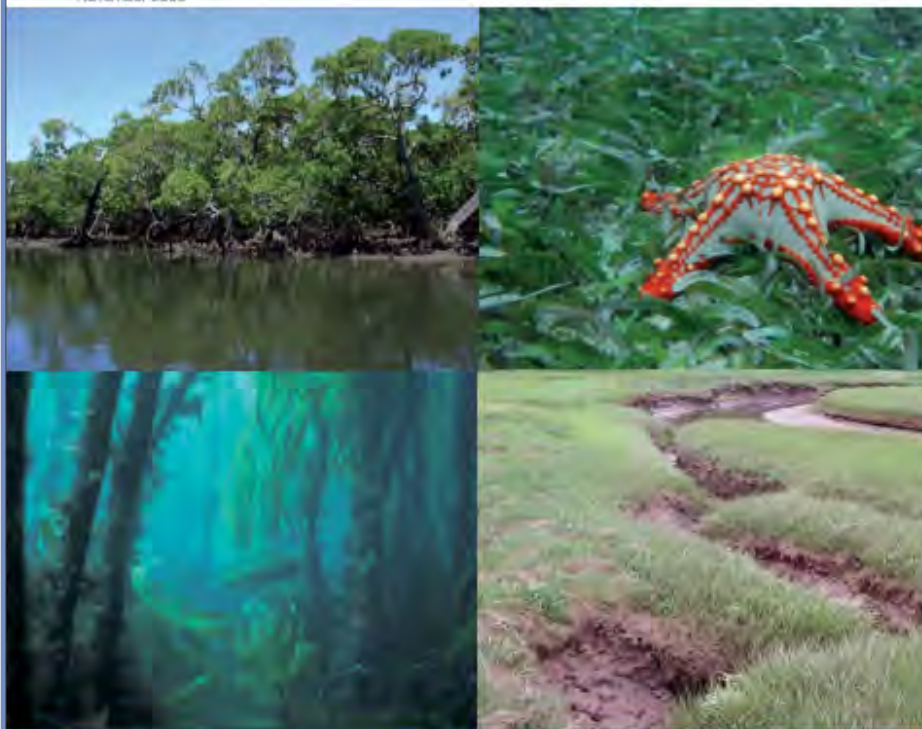
The 2009 stimulus



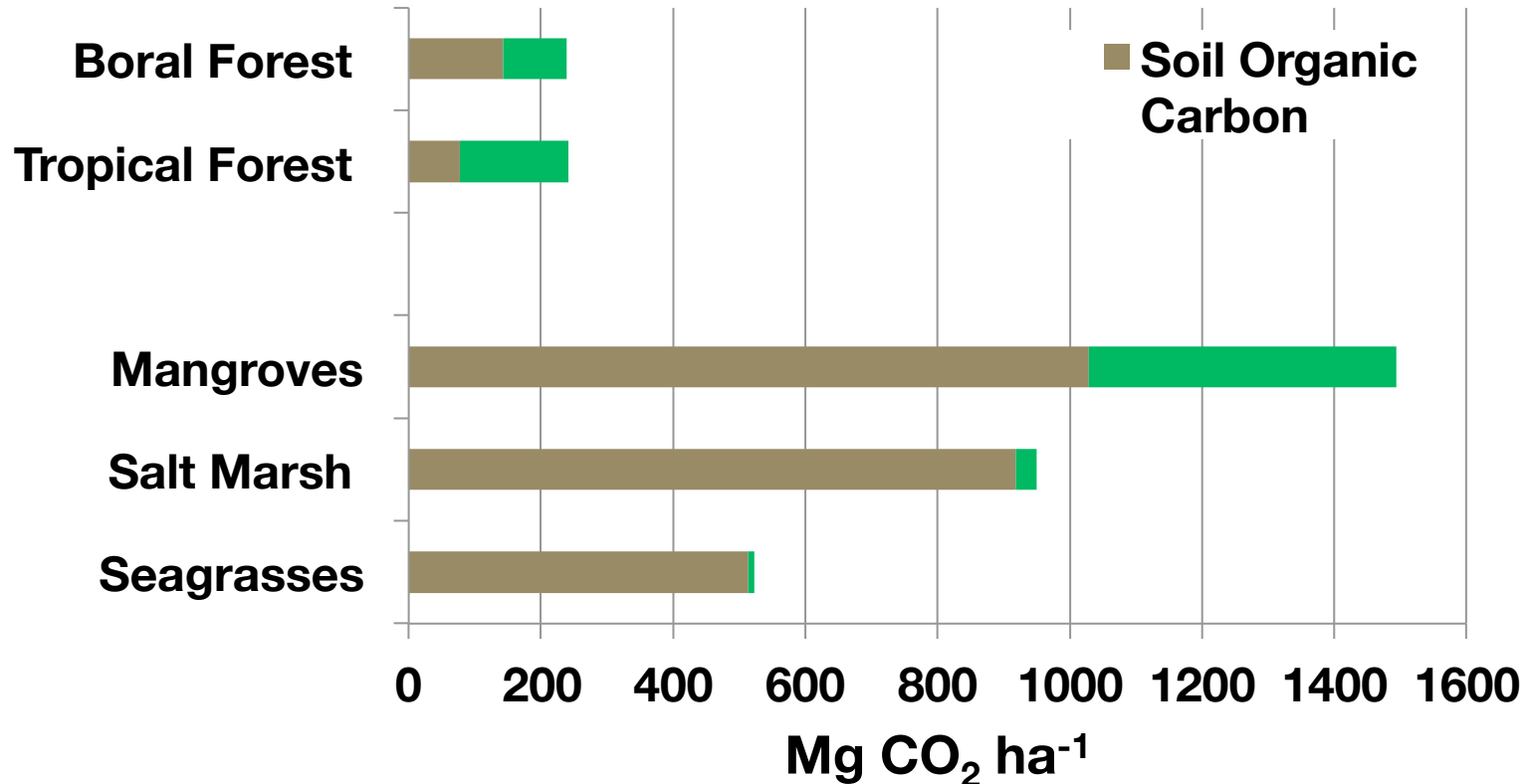
The Management of Natural Coastal Carbon Sinks

Edited by Dan Laffoley and Gabriel Grimsditch

November 2009

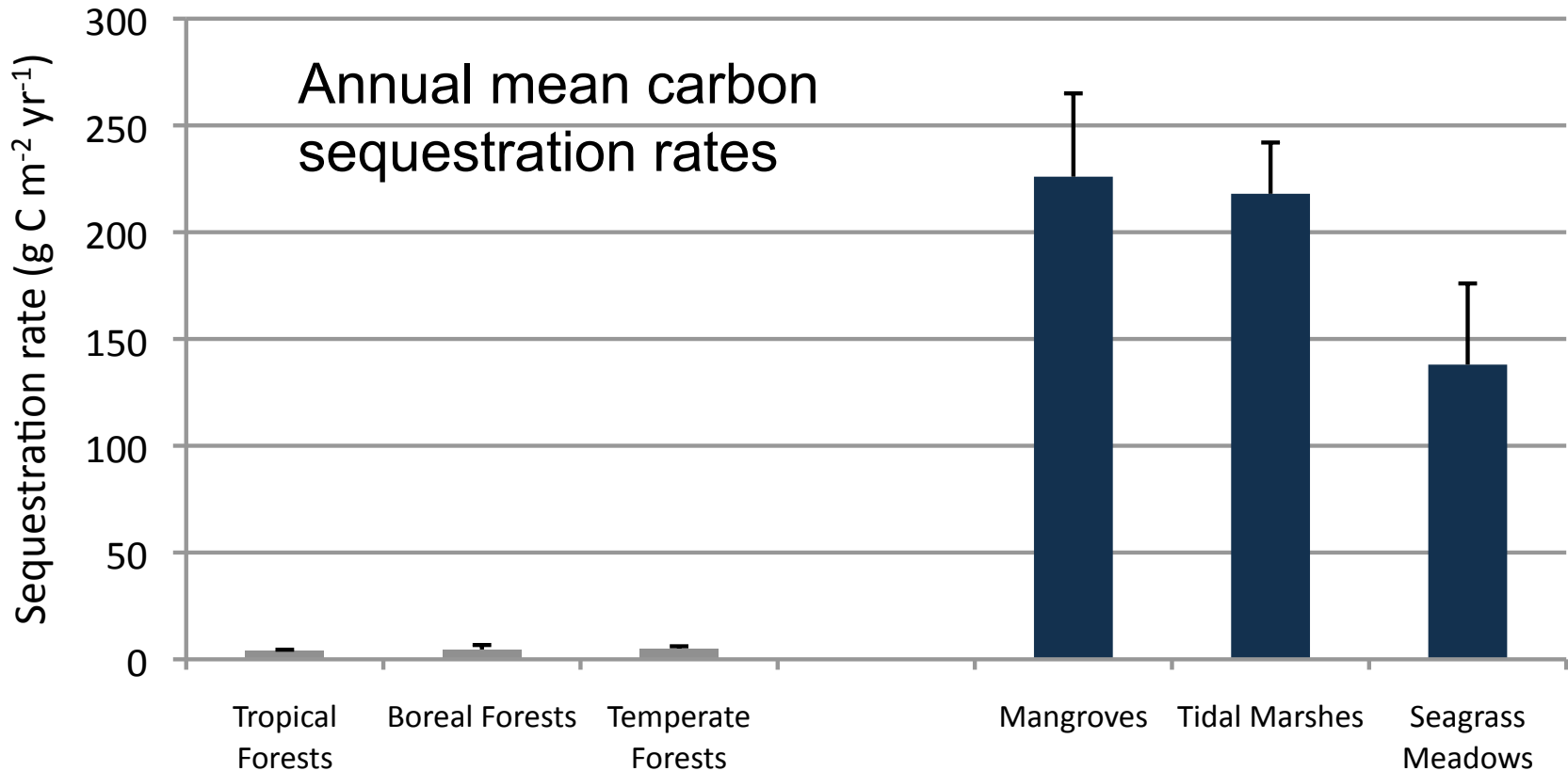


Coastal Ecosystem Have Rich Carbon Stores



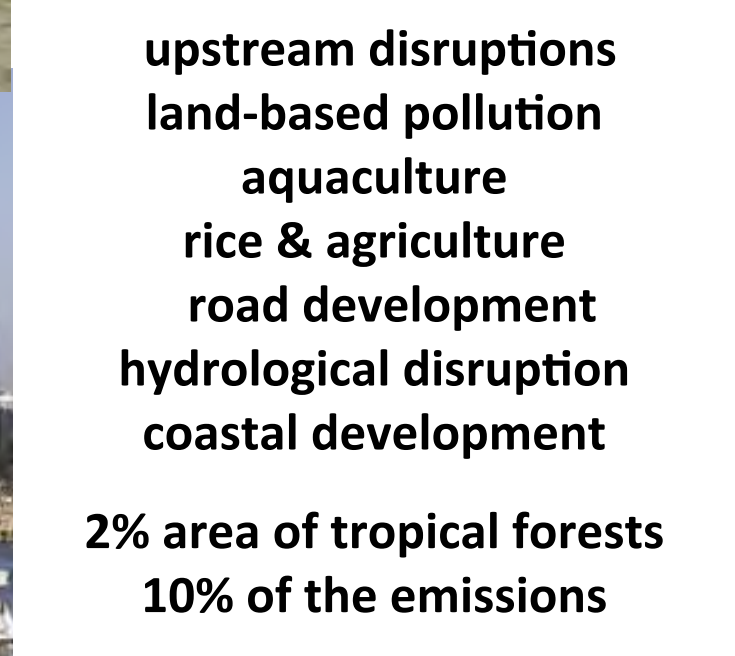
(Fourqurean et al. 2012; Pan et al. 2011; Pendleton et al. 2012)

Costal Ecosystems Highly Efficient at Carbon Sequestration



Modified from McLeod et al. 2011

Coastal ecosystem loss >> Carbon emissions



**upstream disruptions
land-based pollution
aquaculture
rice & agriculture
road development
hydrological disruption
coastal development**

**2% area of tropical forests
10% of the emissions**

Nature-based solutions to climate change

Coastal and marine ecosystems and their contribution to:

- * Mitigation
- * Adaptation



- Active since 2009
- First group of its kind
- Policy and scientific advise
- Negotiations and national implementation

COASTAL BLUE CARBON
methods for assessing carbon stocks and emissions factors in mangroves, tidal salt marshes, and seagrass meadows

the BLUE CARBON initiative

CONSERVATION INTERNATIONAL IUCN United Nations Educational, Scientific and Cultural Organization

BLUE CARBON POLICY FRAMEWORK 2.0
Based on the discussions of the International Blue Carbon Policy Working Group

GUIDANCE FOR NATIONAL BLUE CARBON ACTIVITIES
Fast-tracking national implementation in developing countries

Coastal ecosystems – in particular mangroves, tidal marshes and seagrasses – contain rich carbon reservoirs. When these ecosystems are converted or degraded, they release this stored carbon into the atmosphere and oceans and become sources of greenhouse gas (GHG) emissions. The conservation, restoration and sustainable use of these systems can support climate change, as well as conserve many other benefits these ecosystems provide, such as fisheries support and coastal protection.

A number of developing countries, such as Indonesia, have started to address the conversion and degradation of coastal 'blue carbon' ecosystems through national policy, management and planning. These countries can reduce their GHG emissions and contribute to climate change mitigation.

This brief provides guidance on how to efficiently include blue carbon activities and priorities into national climate change mitigation efforts. It is intended to support national government representatives, NGOs, research institutions and other stakeholders engaged in national climate change policy development and implementation.

High Priority activities for national policy and management include:

- Development of national blue carbon action plans, outlining specific national circumstances, opportunities, needs and limits;
- Conducting national scientific carbon, ecological and socio-economic assessments of shallow coastal marine ecosystems;
- Conducting national cost-benefit analysis of including blue carbon activities into national climate change mitigation strategies, together with a description of the short and long-term benefits of carbon-related finance and activities in coastal areas.

Many countries will likely need to focus on readiness activities that increase national understanding and capacity on the technical, policy and institutional aspects of emissions and removals from blue carbon sinks and reservoirs. Below is an indicative list of activities that should be conducted on a national level to ensure blue carbon is comprehensively included into national level mitigation activities.

Salt marsh core Annapolis, Maryland, USA © Credits by Sarah Hoyt

Global Distribution of Blue Carbon Ecosystems



 Mangroves  Salt Marsh  Seagrass

BLUE CARBON SCIENTIFIC WORKING GROUP

The objectives of the Scientific Working Group are to:

- Describe the **global relevance** of coastal carbon;
- Create internationally applicable **standards for quantifying** and monitoring coastal carbon;
- Develop internationally acceptable **standards for data collection**, quality control and archiving;
- Identify and support **priority research** on carbon dynamics in coastal ecosystems;
- Develop coastal conservation, **planning and management guidelines** for coastal carbon activities; and
- Support the development of **pilot projects** for carbon in coastal ecosystems.

BLUE CARBON POLICY WORKING GROUP

The objectives of the Scientific Working Group are to:

- ❑ Provide a **framework for policy development** that maximizes conservation of carbon in coastal ecosystems and mobilizes the implementation of that framework; and
- ❑ Build an **integrated blue carbon community** that supports policy implementation.

COASTAL BLUE CARBON UNDER THE UNFCCC - OVERVIEW



Figure 1.1 Blue carbon ecosystems: mangroves (top left, © Sterling Zumbrunn, CI), seagrasses (bottom left, © Miguel Angel Muñoz), and tidal salt marshes (right, © Sarah Hoyt, CI)

1992

REDD negotiations started - **R**educing **E**missions from **D**eforestation and forest **D**egradation

2005

Coastal ecosystems discussed as sinks and sources

2009

Technical and scientific aspects
IPCC Wetlands Supplement

2013

2015

INDCs

Aware of the role and importance in ... marine and coastal ecosystems of sinks and reservoirs of GHGs



The Nature Conservancy 

Coastal blue carbon ecosystems

Opportunities for Nationally Determined Contributions,
Policy brief

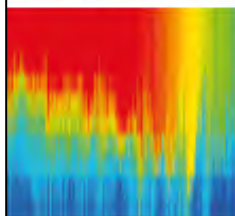
D. Herr, E. Landis



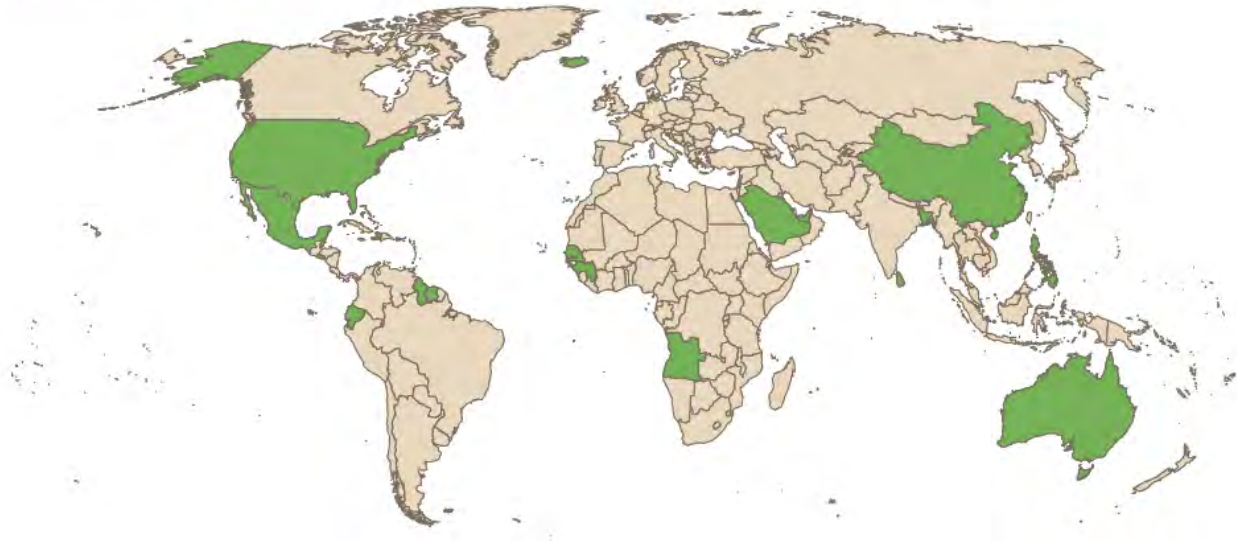
Marine Protected Areas and climate change:

Adaptation and mitigation synergies,
opportunities and challenges

Simard, F., Laffoley, D. and J.M. Baxter (editors)

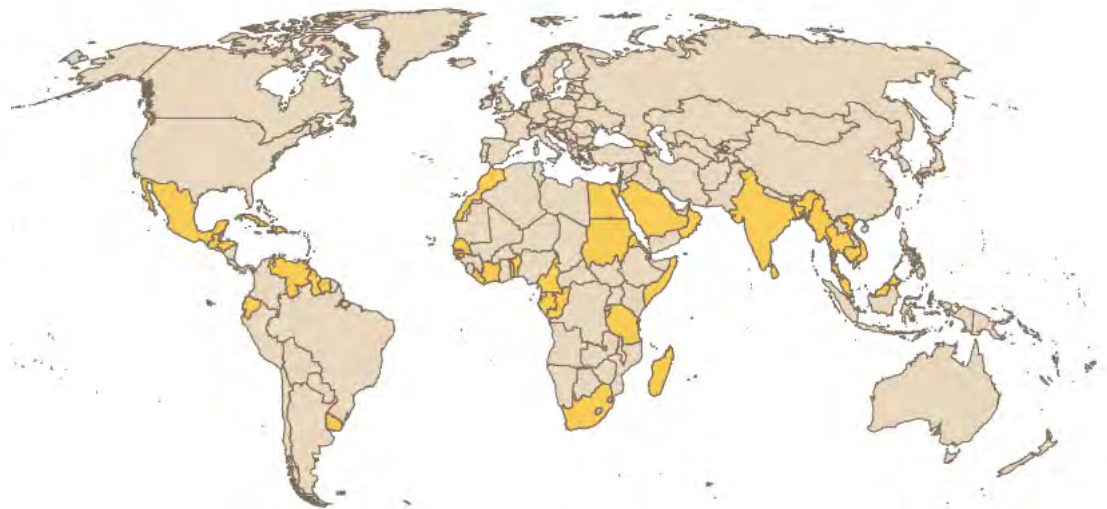


MITIGATION



Blue Carbon in Nationally Determined Contributions

ADAPTATION



The Nature Conservancy



Blue Climate Solutions
A project of The Ocean Foundation

CONSERVATION INTERNATIONAL



GRID ARENDAL

the BLUE CARBON initiative



blue forests



Coastal ecosystem conservation and restoration lead to:

* Ecosystem-based adaptation / EbA



Reduced coastal erosion

Coastal defense

Reduced coastal flooding

Maintained fisheries
nursery ground

Benefits and co-benefits

- biodiversity
- fish nurseries
- water quality
- >> Local livelihoods
- >> Commercial interests

LMMAs

MSP

Fisheries

ICZM

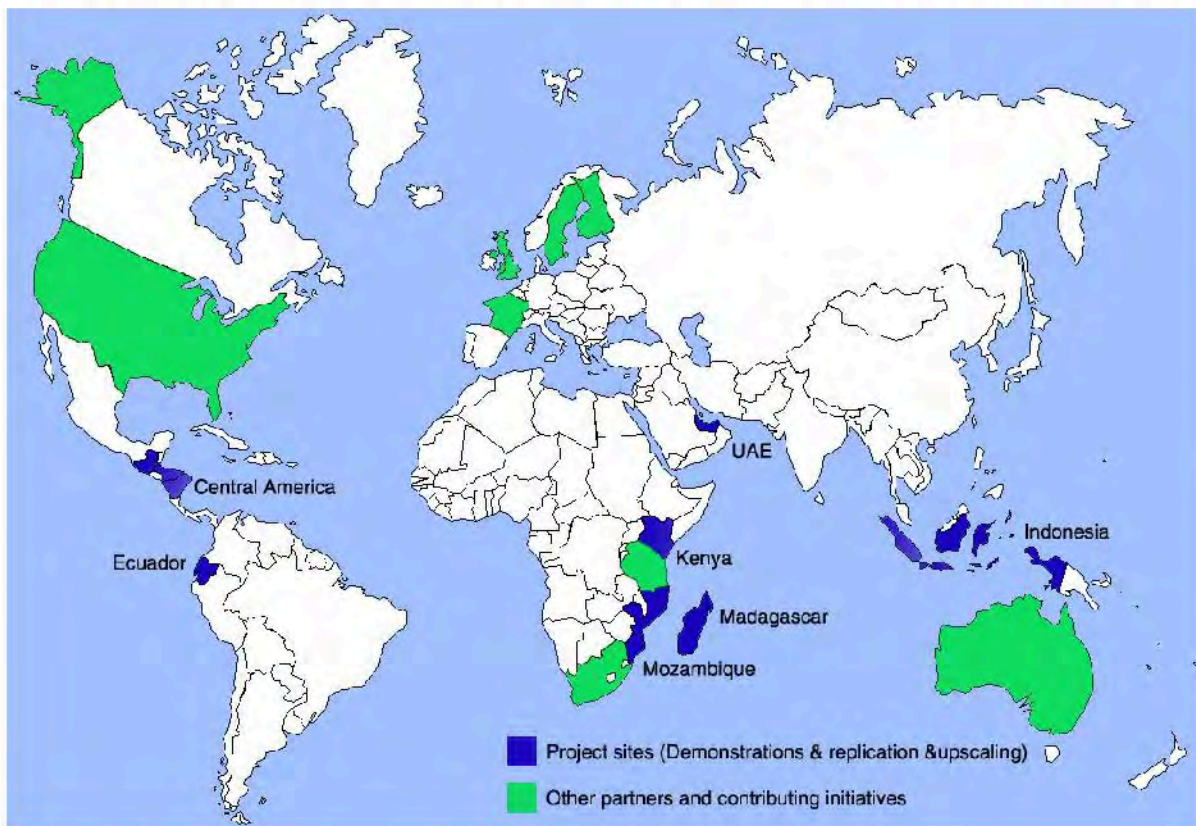
MPAs



blueforests

GEF/UNEP Blue Forests Project

www.gefblueforests.org



Key outputs:

- International demonstration and application of “blue forests” values
- Active experience sharing, learning and replication



- **National policy assessments**
 - Support capacity building
 - Upscaling and replication
-
- Goal ... to trace the policy, legal, and regulatory context for blue carbon ecosystems in five countries
Ecuador, Mozambique, Madagascar, Indonesia & UAE
 - ... to extrapolate common trends, best practices and opportunities for climate-change-based protection and restoration policies



International Partnership for Blue Carbon





Founding Partners

Indonesia

Blue Carbon Initiative: Conservation International, International Union for Conservation of Nature, IOC - UNESCO

Secretariat of the Pacific Regional Environment Program (SPREP)

Centre for International Forestry Research

Australia

Costa Rica

Pacific Islands Forum Secretariat and Office of the Pacific Ocean Commissioner

University of Queensland Global Change Institute

GRID-Arendal

The United States and France recently joined and several other countries and organisations are interested in being involved



The Partnership aims to enhance the protection and restoration of coastal blue carbon ecosystems that sequester carbon in mangroves, tidal marshes and seagrasses by:

- Building awareness;
- Exchanging knowledge; and
- Accelerating practical action in priority regional ‘hot-spots’.



- Australia launched the *International Partnership for Blue Carbon* at the Paris climate change conference in December 2015.
- First Partnership meeting held in Indonesia in August 2016 refined the Partnership's objectives and developed priority actions.
- The Partnership is not a funding body, but instead aims to better connect the efforts of governments, research organisations and non-government organisations. It also aims to build on the significant initiatives already under way in this area.



Explaining Ocean Warming:

Causes, scale, effects and consequences

Edited by D. Laffoley and J. M. Baxter

September 2016

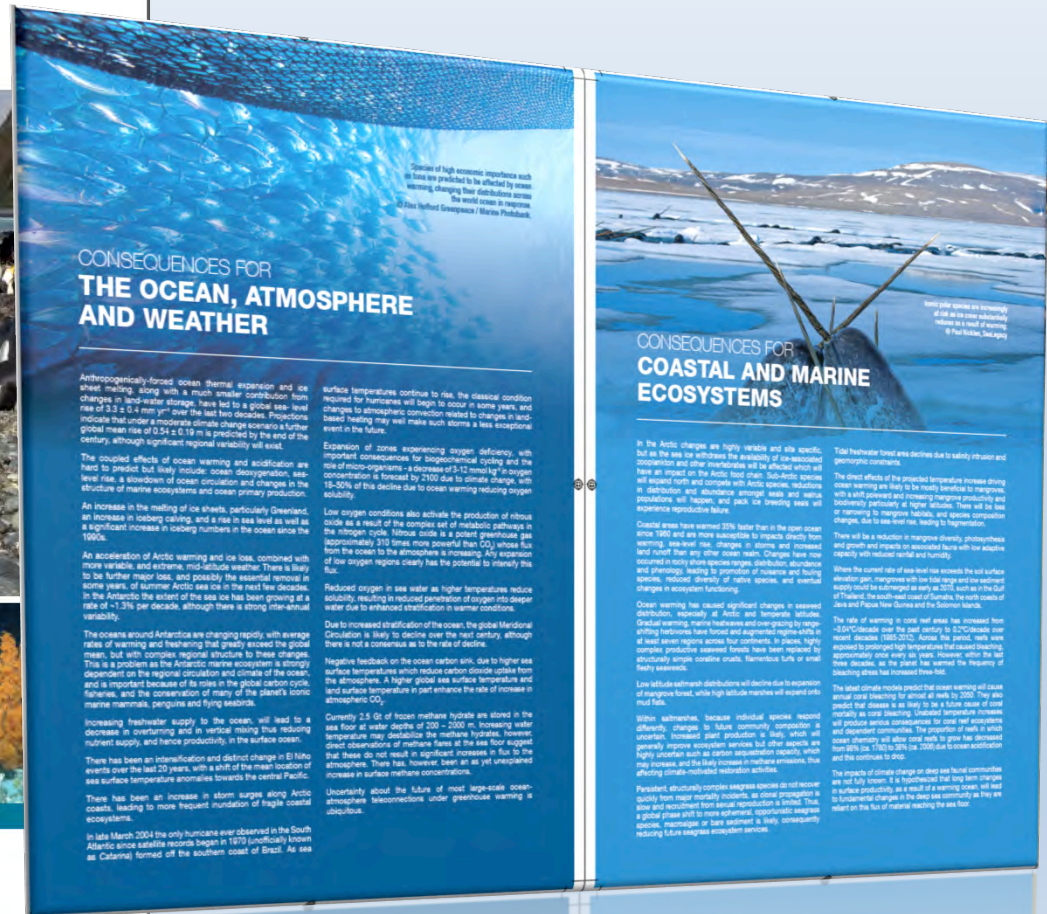


IUCN GLOBAL MARINE AND POLAR PROGRAMME



“Tampering can be dangerous. Nature can be vengeful. We should have a great deal of respect for the planet on which we live.”

Rossby, 1956



CONSEQUENCES FOR THE OCEAN, ATMOSPHERE AND WEATHER

Decision of high economic importance such as warming, changing heat distributions across the world ocean is required. (Walter Hubbert Consequence / Marine Postbuck)

Anthropogenically-forced ocean thermal expansion and sea level rise, along with a much smaller contribution from changes in land-water storage, have led to a global sea-level rise of 3.3 ± 0.4 mm yr⁻¹ over the last two decades. Projections indicate that under a moderate climate change scenario a further global mean rise of 0.24 ± 0.19 m is predicted by the end of the century, although significant regional variability will exist.

The coupled effects of ocean warming and acidification are hard to predict but likely include: ocean deoxygenation, sea-level rise, a slowdown of ocean circulation and changes in the structure of marine ecosystems and ocean primary production.

An increase in the melting of ice sheets, particularly Greenland, an increase in iceberg calving, and a rise in sea level as well as a significant increase in iceberg numbers in the ocean since the 1990s.

An acceleration of Arctic warming and ice loss, combined with more variable, and extreme, mid-latitude weather. There is likely to be further major loss, and possibly the essential removal in some years, of summer Arctic sea ice in the next few decades. In the Arctic the extent of the sea ice has been growing at a rate of +1.3% per decade, although there is strong inter-annual variability.

The oceans around Antarctica are changing rapidly, with average rates of warming and freshening that greatly exceed the global mean, but with complex regional structure to these changes. This is a problem as the Antarctic marine ecosystem is strongly dependent on the regional circulation and climate of the ocean and is important because of its roles in the global carbon cycle, fisheries, and the conservation of many of the planet's iconic marine mammals, penguins and flying seabirds.

Increasing freshwater supply to the ocean, will lead to a decrease in overturning and in vertical mixing that reduces nutrient supply, and hence productivity, in the surface ocean.

There has been an intensification and distinct change in El Niño events over the last 20 years, with a shift of the mean location of sea surface temperature anomalies toward the central Pacific.

There has been an increase in storm surges along Arctic coasts, leading to more frequent inundation of fragile coastal ecosystems.

In late March 2004 the only hurricane ever observed in the South Atlantic since satellite records began in 1970 (officially known as Catarina) formed off the southern coast of Brazil. As sea surface temperatures continue to rise, the classical condition required for hurricanes will begin to occur in some years, and limited melting may well make such storms a less exceptional event in the future.

Expansion of zones experiencing oxygen deficiency, with important consequences for biogeochemical cycling and the rise of anoxic organisms - a decrease of 5-12 mmol kg⁻¹ in oxygen concentration is forecast by 2100 due to climate change, with 15-20% of this decline due to ocean warming reducing oxygen solubility.

Low oxygen conditions also activate the production of nitrous oxide as a result of the complex set of microbial pathways in the nitrogen cycle. Nitrous oxide is a potent greenhouse gas (approximately 310 times more powerful than CO₂) whose flux from the ocean to the atmosphere is increasing. Any expansion of low oxygen regions clearly has the potential to intensify this flux.

Reduced oxygen in sea water as higher temperatures reduce solubility, resulting in reduced penetration of oxygen into deeper water, but enhanced stratification in warmer conditions.

Due to increased stratification of the ocean, the global Meridional Circulation is likely to decline as over the next century, although there is not a consensus as to the rate of decline.

Negative feedback on the ocean carbon sink, due to higher sea surface temperatures which reduce carbon dioxide uptake from the atmosphere. A higher global sea surface temperature and acid surface temperatures in part enhance the rate of increase in atmospheric CO₂.

Currently 2.5 Gt of frozen methane hydrate are stored in the sea floor at water depths of 200 - 2000 m, increasing water temperature may destabilize the methane hydrates, however direct observations of methane flares at the sea floor suggest that these do not result in significant increases in flux to the atmosphere. There has, however, been an as yet unexplained increase in surface methane concentrations.

Uncertainty about the future of most large-scale ocean-atmosphere interactions under ocean warming is ubiquitous.

CONSEQUENCES FOR COASTAL AND MARINE ECOSYSTEMS

In the Arctic changes are highly variable and site specific, but the sea ice withdrawal the availability of ice-associated zooplankton and other invertebrates will be affected, which will impact north and central Arctic species, reductions in distribution and abundance amongst seas and subarctic populations will happen, and pack ice breeding seas will experience reproductive failure.

Coastal areas have warmed 20% faster than in the open ocean since 1980 and are more susceptible to impacts directly from warming, with heat, changes in storms and increased land runoff than any other ocean reach. Changes here may occur in rocky shore species distribution and timing and phenology, leading to population increases and local extinctions, reduced diversity of native species, and eventual changes in ecosystem functioning.

Ocean warming has caused significant changes in seaweed distribution, especially at Arctic and temperate latitudes. Global warming, marine heatwaves and expanding by large-warming latitudes have forced and augmented the shifts at least seven regions across four continents. In place, high coastal production seaweeds have been replaced by seasonally single-celled cyanobacteria, filamentous algae or other highly resilient forms.

Low latitude shallow distributions will decline due to expansion of mangrove forest, while high latitude marshes will expand onto mudflats.

With settlements, because individual species respond differently, changes to future community composition is uncertain. Increased food production is likely, which will generally improve ocean health but other aspects are highly uncertain such as bottom environmental quality, which will increase and the likely increases in methane emissions, which affecting climate-mitigation strategies.

Parasitic, essentially invisible species do not cause a sudden loss of major invertebrates, as global production is largely from major invertebrates. This, too, and recruitment from sexual reproduction is limited. This is a global process and to more extensive, opportunistic seaweeds, algae, invertebrates and sea bed silt, consequently reducing future seaweed recruitment services.

Fish fisheries target areas decline due to salinity intrusion and geomorphic constraints.

The direct effects of the projected temperature increase during ocean warming are likely to be mostly beneficial to mangroves, with both increased and increasing mangrove productivity and biodiversity primary at higher latitudes. There will be less of warming to temperate latitudes, where species composition changes, due to sea-level rise, leading to high temperatures.

There will be a reduction in mangrove diversity, phytoplankton and green and brown algae associated there with the relative stability with mangrove decline and variability.

Where the current rate of sea-level rise exceeds the soil surface elevation gain, mangroves will lose their edge and low-lying wetlands will be submerged early as 2050, and as the Gulf of Thailand, the south-west coast of Sumatra, the north coast of sea level rise from 2000 and the Solomon Islands.

The rate of warming in coral reef areas has exceeded from +0.01°C/decade over the past century to 0.2°C/decade over recent decades (1980-2012). During this period, such sea warming is expected to prolong high temperatures that caused bleaching, storm-related coral death, and, however, within the last few decades, all the planet has warmed. The frequency of bleaching events has increased three-fold.

The latest climate models predict that ocean warming will cause annual coral bleaching to annual at least by 2050. They also predict that bleaching is as likely to a global scale of coral mortality as sea level rise. Unbleached temperature increases will produce serious consequences for coral reef ecosystems and provide serious consequences for coral reef dependent coastal community sustainability. The proportion of reefs with coral cover declines from 60% to 20% by 2050 due to coral mortality and the continued loss of coral.

The impacts of climate change on deep sea benthic communities are not fully known or understood but long term changes in surface productivity, as a result of warming and changes to biogeochemical changes in the deep sea are especially as they are reliant on the flux of material reaching the sea floor.

Blue Carbon Initiative 2017

An underwater photograph showing a dense field of seagrass on the seabed. Sunlight filters through the water from the surface, creating a shimmering effect. The seagrass is green and appears to be growing in a shallow, clear water environment.

When: September 2017

Where: Ibiza

Why: Focus on seagrass and tidal marsh