



# THE OCEAN AND CLIMATE CHANGE

## COASTAL AND MARINE NATURE-BASED SOLUTIONS TO SUPPORT MITIGATION AND ADAPTATION ACTIVITIES

Climate change and ocean acidification are severely and rapidly impacting species, ecosystems and people around the globe. As both international and national strategies to address the challenges are being discussed, it is vital to ensure that the impacts of greenhouse gases (GHG), especially CO<sub>2</sub>, are properly reflected in national emission reduction strategies and that the role of our oceans and coasts in mitigation and adaptation strategies are adequately factored into the solutions proposed.

Over 70% of the planet is covered by the ocean. The ocean is the major regulating force in the earth's climate system and represents the largest carbon sink on the planet. Healthy marine and coastal ecosystems, and their services, are essential to maintain the earth's life support system. Climate change and ocean acidification are jeopardizing food security, shoreline protection, the provision of income, livelihood sources and sustainable economic development.

An accelerated push for rapid and significant action is needed now.

- Action Recommendations for Ecosystem-based Mitigation
- Action Recommendations for Ecosystem-based Adaptation
- The Impacts of Climate Change and Ocean Acidification
- A changing Ocean – A changing Land
- The Need for Immediate Action



Climate change and ocean acidification continue to have serious, adverse impacts on the marine environment with significant implications for people.

Several mitigation approaches are being developed and implemented in order to achieve a significant and rapid decrease in GHG emissions. Coastal ecosystem-based mitigation activities can be used alongside other land use change and forestry activities to reduce ongoing emissions and sequester new carbon.



## QUICK FACTS

The ocean absorbs nearly one third of all the carbon dioxide (CO<sub>2</sub>) we emit each year.

Increased levels of CO<sub>2</sub> in the atmosphere and thus in the ocean cause ocean acidification.

The ocean's capacity to store new carbon emissions is decreasing, thus more significant CO<sub>2</sub> mitigation actions are needed in order to lower the impacts of climate change.

Vital coastal carbon sinks are being damaged and lost at a dangerous rate, thus contributing to climate change.

Healthy and resilient ecosystems support climate change mitigation strategies.



## SIGNIFICANTLY AND RAPIDLY CUT GREENHOUSE GAS EMISSIONS

- Set stabilization targets for atmospheric CO<sub>2</sub> which adequately reflect not just warming of land but particularly the impacts of anthropogenic carbon on the ocean (i.e. ocean acidification) and the significant warming effects on the global ocean.
- Include the environmental and social costs of ocean acidification and ocean warming in climate change mitigation actions.
- Utilize ocean expertise in climate change mitigation decision making and planning processes.

## RETAIN, MAINTAIN AND RESTORE NATURAL COASTAL CARBON SINKS

- Effectively apply carbon and coastal management, conservation and restoration strategies, including REDD+, NAMAs, MPAs and integrated coastal zone management, to increase the world's natural coastal carbon sinks (mangroves, salt marshes and seagrasses) and support other ecosystem functions and services.
- Build and improve upon simulation models, in collaboration with field studies, to develop tools for improving and enhancing management plans, including optimal scenarios for carbon allocation, CO<sub>2</sub> uptake and carbon management schemes.
- Apply the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands in national GHG accounting.

## PROMOTE RESEARCH AND MONITORING OF THE OCEAN'S ROLE IN THE GLOBAL CARBON CYCLE

- Recognize the role of marine ecosystems, including the deep sea, as vital global carbon pools and sinks.
- Enhance long-term monitoring of carbon in the ocean and support further efforts to quantify the ocean's role in the global carbon cycle.
- Engage industry and sectoral management bodies in efforts to enhance research, monitoring and sharing of data on ocean health, human activities and impacts and the ocean's role in the Earth system, including the global carbon cycle.





### DEPLOY CARBON CAPTURE AND STORAGE (CCS) WITH EXTREME CAUTION

- Refrain from directly altering ocean chemistry by injecting CO<sub>2</sub> into the water column or the deep-sea.
- Refrain from setting investment incentives that could divert attention from the development and deployment of other more environmentally-friendly mitigation strategies.
- Adopt effective measures and regulations, on global, regional and national scales, to ensure that potential risks of CCS schemes have been carefully considered.
- Introduce permits for CCS projects only if based on prior environmental impact assessments, advanced notification and consultation, and use of independent scientific reviews.
- Require continuous monitoring, reporting and inspection of CCS sites.

### APPROACH LARGE-SCALE MARINE GEO-ENGINEERING ACTIVITIES WITH EXTREME CAUTION

- Prohibit large-scale ocean fertilization and other geo-engineering activities with a potential to impact ocean and coastal ecosystems or communities until there is sufficient scientific basis on which to justify such activities.
- Refrain from selling or offering carbon credits or offsets for ocean fertilization or other geo-engineering projects unless their safety, long-term effectiveness and net environmental benefits have been established.
- Develop and implement a transparent and effective regulatory mechanism for geo-engineering-related research to ensure that these activities are subject to appropriate control and consultation.



### WHAT IS THE IUCN GLOBAL MARINE AND POLAR PROGRAMME DOING?

The **Blue Carbon Initiative** is a global programme working to mitigate climate change through the restoration and sustainable use of coastal and marine ecosystems. It brings together governments, research institutions, non-governmental organisations and communities from around the world. It is coordinated by IUCN, Conservation International (CI) and the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific, and Cultural Organization (IOC-UNESCO).

The **GEF Blue Forests project** builds on existing activities in selected countries to apply the blue forests concept - the promotion of better coastal ecosystem management by harnessing the values associated with carbon and other ecosystem services - from theory to practical application.

The **Ocean Acidification international Reference User Group (OA-iRUG)** is a key means of conveying scientific results to non-scientific audiences and science end-users, in particular policy and decision makers. It brings together scientists and stakeholders from various backgrounds such as industry, governmental and non-governmental organizations, to allow networking and the presentation of key findings to interested non-scientific parties.



# ACTION RECOMMENDATIONS FOR ECOSYSTEM-BASED ADAPTATION

Mitigation is absolutely essential to avoid long-term climate change and ocean acidification, the impacts of which are already seen and felt by humans and natural ecosystems in many regions of the world.

Due to geophysical time-lags, the consequences of ocean warming and ocean acidification will continue to become more pronounced for decades to come. Ecosystem-based adaptation (EbA), as part of larger climate change adaptation portfolios, can support and help people adapt to climate change.



## What is EbA?

EbA is the sustainable management, conservation and restoration of ecosystems to assure the continued provision of vital services that help people adapt to the adverse effects of climate change.

EbA increases ecosystem resilience to reduce human vulnerability in the face of climate change and can be applied to coastal and marine ecosystems to ensure that they are able to continue to provide vital services (e.g. storm protection).

EbA strategies can be more cost-effective than physical infrastructures and engineering projects and are often more accessible to the rural poor.



## CONDUCT VULNERABILITY ASSESSMENTS AND ECOSYSTEM MAPPING

- In order to determine the priorities and urgency with which EbA strategies should be implemented
- Obtain information regarding the relative magnitude of social and environmental impacts and costs of climate change and ocean acidification.
- Gather and analyze information on ecosystems (mapping, service provision, non climate impact assessment)
- Develop EbA plans with properly targeted scenarios and strategies, included in larger national and sub-national planning efforts (national development plans and marine spatial plans) and prepare for adaptive management responses.



## IDENTIFY AND ENSURE EFFECTIVENESS OF EBA AS AN ADAPTATION OPTION

- Conduct cost-benefit analysis and consider, as appropriate, linking EbA with hard(er) infrastructure
- Increase ecosystem resilience and ensure continued provision of ecosystem services by reducing other human stressors on the marine environment, including: pollution, destructive fishing practices, habitat destruction and unsustainable coastal development.
- Protect natural buffers and plan for inward migration of coastal ecosystems such as mangroves and wetlands.
- Integrate the full suite of EbA actions into poverty reduction, sustainable development plans and disaster risk reduction strategies, whenever possible.

## STRENGTHEN AND DEVELOP LONG-TERM MONITORING AND RESEARCH PROGRAMS

- Ensure long-term monitoring to allow for adaptive management actions.
- Incorporate socio-economics into environmental monitoring projects.
- Determine top research priorities and support the most appropriate existing institutions in their implementation.
- Support local and regional scientific institutions so that low-resolution, global findings can be applied to local and regional stakeholders.





### DEVELOP ADEQUATE FINANCIAL SUPPORT FOR EbA

- Eliminate subsidies and other incentives for unsustainable coastal and marine development projects and replace them with economic rewards for projects that undertake EbA and a wider ecosystem-based approach to development.
- Eliminate subsidized insurance and other benefits for development projects that alter natural systems to an extent that increases risk.
- Manage climate-related socio-economic issues with traditional development goals to ensure that both can be achieved without competing for limited human and financial resources.
- Integrate EbA into the policies of regional and international development banks to ensure adequate implementation and funding of EbA.



### CREATE COMPREHENSIVE NETWORKS OF MARINE PROTECTED AREAS (MPAS)

- Significantly increase the size and number of fully protected areas to allow ecosystems to recover their full suite of services.
- Increase effectiveness of existing MPAs and ensure proper implementation of new MPAs and other area-based management activities (LLMAs, etc).
- Encourage connectivity synergies between coastal and marine ecosystems by protecting ecological corridors.
- Promote the establishment of ecologically representative networks of MPAs within and beyond national jurisdiction to protect ecosystem structure, functioning and processes at the regional scale.
- Establish “Predictive Protected Areas,” which provide some level of protection for areas expected to provide future refugia and areas that have demonstrated some resilience to the effects of climate change.
- Develop and implement new, creative enforcement mechanisms (e.g. locally empowered enforcement processes).

### RESTORE FRAGMENTED OR DEGRADED ECOSYSTEMS, AND REESTABLISH CRITICAL PROCESSES

- Undertake marine ecosystem restoration projects (e.g. seeding, transplanting, or assisting colonization of coastal and marine plants, eliminating invasive species, demolishing unnecessary or unused structures, etc.) where appropriate.
- Develop and strengthen community-based restoration programs.
- Include sustainable use of ecosystem services as part of the design, implementation and management of restoration projects and sites.

### WHAT IS IUCN GMPP DOING?

The goal of project **REGENERATE** is to develop a Resilience-Based Management framework to improve the ability of policy-makers and stakeholders in the Maldives to understand and address the risks from global, regional and local-scale pressures on their environment.

The **BEST** project aims to strengthen biodiversity conservation and climate change adaptation in Europe overseas by raising Europe overseas’ profile and generating support for action; and by proposing mechanisms to enhance biodiversity and climate change policies and programmes targeted at Europe overseas.

Through the **Blue Solutions** project, four leading environment, conservation and development institutions combine their efforts to develop and bring together innovative marine and coastal management approaches and policy advice – focusing on holistic solutions for a sustainable use of marine and coastal resources.

# OCEAN ACIDIFICATION AND OCEAN WARMING

CO<sub>2</sub>

The ocean and its ecosystems sustain life on Earth by cycling oxygen and CO<sub>2</sub>, regulating climate and temperature, and providing millions of people with food and income. However, these benefits and services are in jeopardy.

Sea-level rise, increased intensity of storms, changes in ocean productivity and resource availability, disruption of seasonal weather patterns, loss of sea ice, altered freshwater supply and quality are impacting local livelihoods, global economies, food security and human health. Due to significant geophysical time lags, anthropogenic effects on these natural processes will continue to affect the state of the world's ocean for millennia to come.



## WHY DOES OCEAN ACIDIFICATION MATTER?

- A reduced or functionally impaired capacity of the ocean to store carbon leaves more CO<sub>2</sub> in the atmosphere. This requires more significant CO<sub>2</sub> emission reductions in order to lower the impacts of climate change.
- As calcification rates of corals decrease, coral reefs are eroding at a faster rate than they are created. This loss has negative effects on the reproduction and life cycle of organisms that depend on reefs, as well as severe implications for the people who rely on them for shore protection, food and income.
- Ocean acidification has direct effects on commercially viable species by reducing the calcification rates of shellfish such as mussels and oysters. Impacts on planktonic primary producers can be expected to resonate throughout entire food webs and marine ecosystems and jeopardize commercial species by reducing their food supply.

### OCEAN ACIDIFICATION

Part of the atmospheric CO<sub>2</sub> dissolves in the ocean and reduces its pH level (i.e. the ocean becomes more acidic)

As atmospheric CO<sub>2</sub> increases

Ocean acidity increases

### CLIMATE REGULATION

The ocean plays a critical role in the global carbon cycle, especially in helping regulate the amount of CO<sub>2</sub> in the atmosphere.

Impacts include:

- The continued uptake of CO<sub>2</sub> by the ocean leads to a reduced global capacity of the ocean to absorb carbon

### ECOSYSTEMS

Ocean acidification has a negative impact on many marine organisms and ecosystems.

Impacts include:

- Reduced ability of many key marine organisms, such as corals, plankton and shellfish, to build their shells and skeletal structures
- Increased physiological stress (e.g. growth, respiration, reproduction)
- Reduced growth and survival of early life stages of some species

### SYNERGISTIC EFFECTS

Ocean acidification and climate change do not operate in isolation but are impacting the marine environment in multiple interactive ways. Ocean acidification, for example, increases the sensitivity of corals to thermal stress, with coral bleaching occurring at lower temperatures when exposed to lower pH.

**ECOSYSTEM DEGRADATION =  
REDUCED ECOSYSTEM SERVICES**

## OCEAN WARMING

The ocean interacts with the atmosphere by exchanging and storing heat.

As atmospheric temperature increases

Ocean surface temperature increases

### CLIMATE REGULATION

The ocean plays an integral part in influencing the global climate.

Impacts include:

- Increased intensity of extreme weather events
- Changes in ocean currents

### ECOSYSTEMS

Ocean warming negatively impacts many marine organisms and ecosystems.

Impacts include:

- Increased ocean stratification; decreased ocean mixing
- Changes in the geographical ranges of marine species
- Decreased oxygen levels and nutrient availability in surface waters
- Changes in diversity and abundance of certain marine organisms
- Exceeding thermal thresholds (e.g. coral bleaching)

### SEA-LEVEL RISE

As seawater warms, it expands, and the ocean surface rises. The melting of inland glaciers and inland ice, due to high atmospheric temperatures, accelerates sea-level rise.

Impacts include:

- Beach erosion
- Saltwater intrusion
- Habitat destruction

### OTHER HUMAN STRESSORS

Climate change and ocean acidification also interact with other human stressors exacerbating ecosystem degradation. Coastal and marine ecosystems are subject to stress from local and regional factors, such as overfishing, pollution, declining water quality and habitat destruction, and are more likely to exhibit diminished resilience in the face of climate change and ocean acidification.

## WHY DOES OCEAN WARMING MATTER?

- An increase in extreme weather events endanger coastal populations and damage coastal infrastructure.
- Instabilities in ocean currents could lead to shifts in regional climate and weather patterns and trigger human migration.
- Ocean stratification impedes the mixing of ocean layers and prevents valuable nutrients from reaching surface waters.
- Permanent migration of species to higher latitudes and deeper depths could cause changes in local availability, endangering food supply and altering traditional fishing grounds and rights.
- Impacts on primary producers such as phytoplankton cause changes in species composition and biomass in pelagic communities. These changes could affect all levels of the marine food web.
- Some marine organisms could approach physiological thresholds in temperature (e.g. coral bleaching).
- Rising sea levels increase beach erosion and saltwater intrusion jeopardizing shore protection and coastal infrastructure, impacting human health, and risking human displacement.



Healthy and well functioning ecosystems are extremely valuable for climate change mitigation and adaptation strategies. Healthy marine ecosystems sequester more carbon than degraded systems and help people adapt to a changing climate. These ecosystems provide services and exhibit higher resilience to other problems. Therefore, it is essential to actively reduce destructive coastal and marine practices and implement conservation initiatives that focus on maintaining a functioning environment for future generations.



# A CHANGING OCEAN – A CHANGING LAND!

People, the ocean and the climate are inextricably linked: the circulation patterns of ocean currents make our planet inhabitable; about half of the oxygen in the atmosphere is derived from oceanic sources; and large sectors of the global economy depend on ocean-related commerce, including fisheries, tourism and shipping. People all over the world rely on the ocean for their basic caloric needs, and some coastal people obtain 100% of their animal protein from its waters. Regardless of where we reside, we depend on healthy ocean ecosystems and the services that they provide.



## FROM THE DEEP SEA...

Studies show that deep ocean circulation and water mass characteristics, such as the level of oxygen, are impacted by climate change. The time scale of complete deep ocean circulation is 100-1000 years and consequences of climate change on the deep ocean will occur over the same period of time.

One of the consequences of climate change on the marine biosphere and notably in high seas areas will be a shift in species distribution. It is expected that a large number of species will shift towards areas with their preferred range of temperature and salinity as they are not able to adapt physiologically at the same speed as climate change induced by human activities.

The long-term consequences of climate change not only on the ocean's physical characteristics, but also on the living part of the ocean, are not well understood and barely predictable, but there is no part of the ocean that will remain unchanged in the context of global climate change.

## ... TO THE ATMOSPHERE

The ocean plays an integral part in influencing the global climate. Both regional and global climate patterns depend on long-term interactions between the ocean and the atmosphere: heat storage, transportation of heat around the globe, wind, evaporation and precipitation patterns, freezing and thawing in polar regions, gas storage and exchange (including CO<sub>2</sub>).

The ocean naturally buffers and equilibrates with the atmosphere. Changes in the ocean-atmosphere coupled climate system could have significant impacts on regional climate systems, including new current, wind, and precipitation patterns, affecting various local and regional processes on land.

The consistency of ocean currents keeps regions around the globe from experiencing large climatic and seasonal swings that they might otherwise experience. Instabilities in ocean currents caused by climate change could lead to major shifts in regional climate and weather patterns and potential human displacement.

Changing precipitation patterns will leave dry regions with even less rainfall, impede the replenishment of mountain glaciers and snow, and lead to intermittent destructive flooding interspersed with long, dry periods.



**The ocean  
is the life  
support  
system for  
our planet.**





## CLIMATE CHANGE AND ISLANDS

Over 100,000 islands worldwide spreading from the polar ice caps to tropical support 20% of global biodiversity and important natural resources. They provide homes to more than 700 million people, 10% of the global population who depend on the services that the ocean provides. But their isolation and unique ecological and cultural characteristics also makes islands fragile ecosystems and particularly vulnerable to the impacts of climate change.

With global changes in climate, islands are already hit more often by extreme storms, whose consequences are exacerbated by degrading and damaged coral reefs, destroyed coastal mangrove zones and diminished seagrass beds. Often densely populated islands also face rising seawater levels, fresh water scarcity, eroding coastlines and severe flooding caused by more frequent heavy rainfall due to climate change.

While climate change adaptation should be an urgent priority for islands, funding is often limited and implementation is, in some cases, poorly managed. Profit-driven economic development often does not incorporate ecosystem restoration measures. Nevertheless many positive examples can be found among the world's islands. Many island states incorporate nature-based solutions and ecosystem-based approaches for sustainable development as well as investing in restoration of ecosystems.

## WHAT IS IUCN GMPP DOING?

The overall objective of the **Seamounts Project** is to develop ecosystem-based approaches to fisheries management for areas of significant biological and commercial importance (i.e. seamounts) located in areas beyond national jurisdiction, the high seas.

In conjunction with the IUCN Environmental Law Programme, the World Commission on Environmental Law and the World Commission on Protected Areas, the **Global Ocean Governance Project** is working with governments to design and adopt a legally-binding Implementing Agreement for conservation and sustainable use of marine biodiversity beyond national jurisdiction.

The **Sargasso Sea Commission**, hosted and partnered by IUCN, is pioneering an intergovernmental mechanism for the Sargasso Sea to keep its health, productivity and resilience under continual review and to promote the adoption of protective measures using existing legal instruments and tools through collaborative initiatives with governments, scientists, industry, NGOs and other partners.



## IN NUMBERS:

- The ocean covers more than 70% of the planet's surface.
- Only 3.4% of the ocean is currently protected.
- It is estimated that 95% of the ocean remains unexplored.
- Thirteen of the world's 20 megacities lie along coasts and nearly 700 million people live less than ten meters above sea level.
- Fish provides a source of protein to nearly three billion people
- It is estimated that by 2050, adverse effects associated with global climate change will result in the displacement of between 50 and 200 million people globally.
- The Arctic will be totally ice-free during the summer in less than 30 years.
- Ocean acidification has increased by 30% since the beginning of the industrial revolution and the rate of acidification is expected to accelerate in coming decades.
- Many of the currently remaining coral reefs may be lost to coral bleaching over the next 20 to 40 years.
- Seventy percent of known cold-water stony coral ecosystems will no longer be able to maintain calcified skeletal structures by 2100.
- Mangroves have been reduced to 30% - 50% of their historical cover.
- Land-based sources account for approximately 80% of marine pollution, globally.

# THE NEED FOR IMMEDIATE ACTION

## THE COSTS OF POLICY INACTION

Several studies have concluded that the economic damage resulting from future climate change will be much higher than the costs for current climate change mitigation and adaptation actions. Although it is extremely difficult to present exact economic numbers on the costs of inaction, they will be substantial.

Numerous reports outline the value that ocean economic activities (e.g. tourism and recreation, transportation, living and mineral resource extractions) contribute to national economies, foreign exchange receipts, government tax revenues and employment.

Governments cannot afford to ignore proper management and conservation strategies or overlook nature-based solutions for climate change mitigation and adaptation. Many projects have started around the world, but further, long-term planning and investments in the management, conservation and protection of ecosystems and their services will not only help to build social resilience to climate change, but will provide vast development returns by reducing poverty, strengthening livelihoods and supporting sustainable economic growth.

Investments in risk reduction strategies are within the commercial interests of private landowners and the tourism and insurance industries. Furthermore, projected additional impacts of climate change on fish populations should serve to warn the fisheries sector of the risk to the industry and the importance of conserving current stocks.



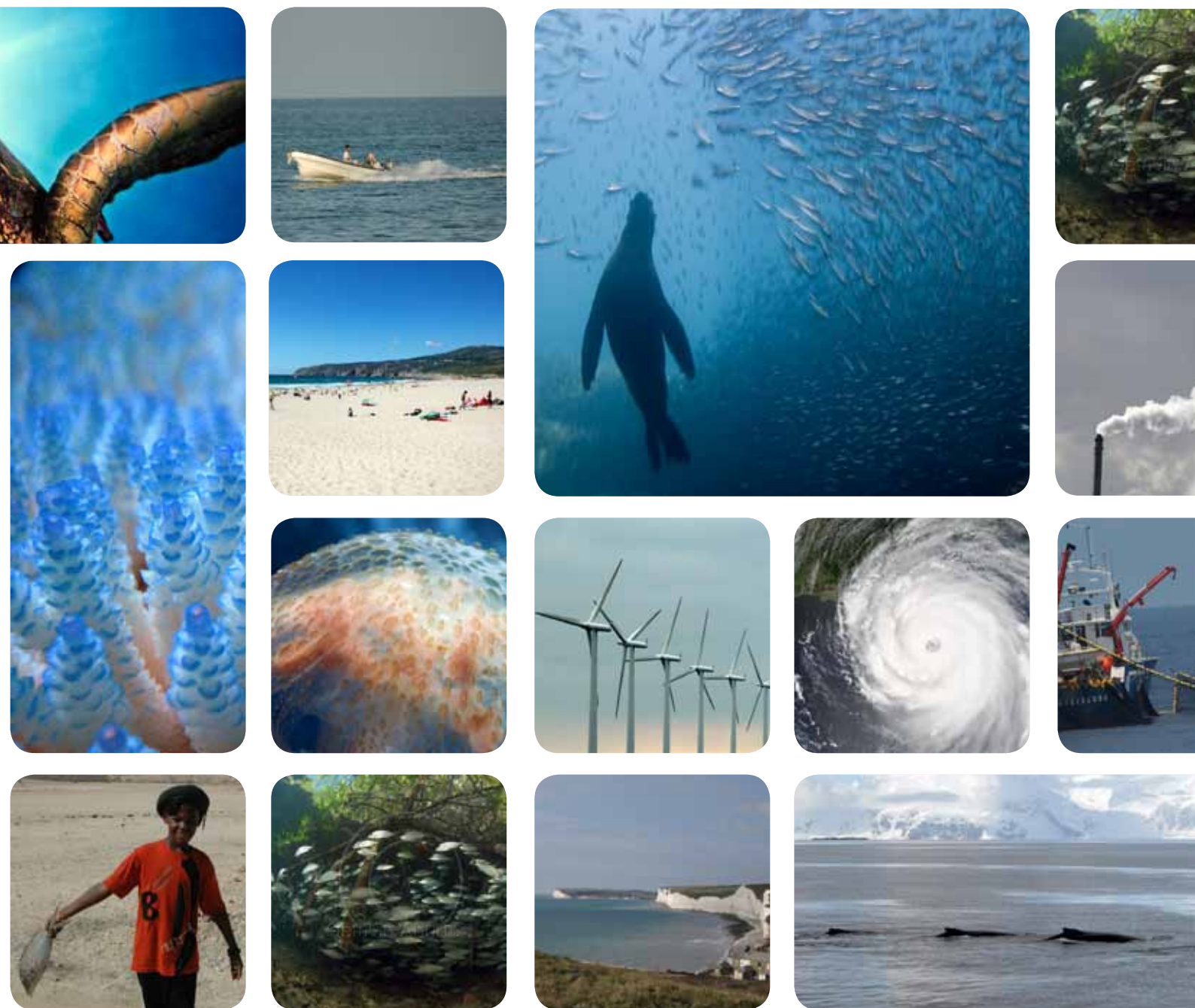
## THE NEED TO CONNECT CLIMATE AND OCEAN MANAGEMENT AND POLICY MAKING

Better conserved and restored coastal and marine ecosystems provide coastal communities with direct adaptation benefits (i.e. coastal protection) while globally supporting mitigation activities. On top of that, they also support various economic sectors, including small- and large-scale commercial fishing activities, tourism and shipping.

An integrated approach is necessary to ensure the myriad of ecosystem services stay intact or are restored and impacts – global to local – are addressed. This requires thorough analysis and harmonization of existing policies and measures which use policy and financial incentive mechanisms jointly from a climate change as well as coastal and marine management perspective. Tools such as Marine Spatial Planning need to be effectively deployed and linked up with national climate change and development planning needs and efforts.

When financing and implementing climate change mitigation and adaptation strategies, it is important to understand and demonstrate the dependence of world economies on healthy ecosystems, both in terms of their market and non-market values. Increased dialogue and collaboration amongst economists and natural scientists should be promoted, in order to provide more accurate policy-relevant valuation of ecosystem services, including for climate change adaptation and mitigation.





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This brochure is based on a previous edition of 'The Oceans and Climate Change –Tools and Guidelines for Action'. Input to this brochure has been provided by various GMPP staff. This brochure has been made possible with the support of the Foundation Prince Albert II of Monaco.

## About IUCN

IUCN, International Union for Conservation of Nature, helps the world find pragmatic solutions to our most pressing environment and development challenges.

IUCN's work focuses on valuing and conserving nature, ensuring effective and equitable governance of its use, and deploying nature-based solutions to global challenges in climate, food and development. IUCN supports scientific research, manages field projects all over the world, and brings governments, NGOs, the UN and companies together to develop policy, laws and best practice.

IUCN is the world's oldest and largest global environmental organisation, with more than 1,200 government and NGO Members and almost 11,000 volunteer experts in some 160 countries. IUCN's work is supported by over 1,000 staff in 45 offices and hundreds of partners in public, NGO and private sectors around the world.

## About the Global Marine and Polar Programme

Working alongside the world's leading marine experts, IUCN's Global Marine and Polar Programme brings forth science and new technologies for the sustainable management and conservation of marine ecosystems by connecting scientists, conservationists, private and public sector partners across its extensive network.

## Further details and contacts

Further details on IUCN's work can be found at [www.iucn.org](http://www.iucn.org)

Further details on GMPP's work can be found at [www.iucn.org/marine/](http://www.iucn.org/marine/)

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