THE OCEAN AND CLIMATE CHANGE

TOOLS AND GUIDELINES FOR ACTION

Climate change is severely and rapidly impacting species, ecosystems and people around the globe. As both international and national mitigation and adaptation strategies are being discussed, the impacts of climate change and ocean acidification on the ocean, as well as the ocean's role in mitigation and adaptation strategies, has largely been overlooked.

70% of our planet consists of 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 and livelihood sources and sustainable economic development.

Rapid and significant action is needed now! This brochure highlights the most pressing climate change related ocean issues and presents a set of tools and guidelines for the implementation of marine climate change mitigation and adaptation strategies.

- Action Recommendations for Mitigation Strategies
- Action Recommendations for Ecosystem-based Adaptation
- The Impacts of Climate Change and Ocean Acidification
- A changing Ocean – A changing Land!
- Invest in the Ocean now!







ACTION RECOMMENDATIONS FOR MITIGATION STRATEGIES

Climate change and ocean acidification will continue to have devastating adverse impacts on the marine environment with significant implications for people. These impacts must be considered when setting greenhouse gas (GHG) emission reduction targets and strategies.

Several mitigation approaches are being developed and implemented in order to achieve significant and rapid GHG emission reductions. Such mitigation portfolios should include responsible, well-researched marine and coastal strategies

SHORT FACTS

- The ocean absorbs nearly one third of all the carbon dioxide (CO2) we emit each year.
- Increased levels of CO2 in the ocean cause ocean acidification.
- The ocean's capacity to store carbon emissions is decreasing. This calls for more significantCO2 mitigation actions in order to lower the impacts of climate change.
- Vital coastal carbon sinks are being damaged at a dangerous rate.
- Healthy ecosystems support climate change mitigation strategies.

SIGNIFICANTLY AND RAPIDLY CUT GREENHOUSE GAS EMISSIONS

- Set stabilization targets for atmospheric CO2 which adequately reflect the impacts of ocean acidification.
- Include the environmental and social costs of ocean acidification for in climate change mitigation actions.
- Include ocean expertise in the climate change mitigation decision-making and revision process.

RETAIN, MAINTAIN AND RESTORE NATURAL CARBON SINKS

- Increase the ocean's natural carbon sink.
- Use and improve tools that enhance management plans for coastal and oceanic ecosystem protection, rehabilitation and restoration, including optimal scenarios for carbon allocation and CO2 uptake.

RECOGNIZE THE OCEAN'S CRUCIAL ROLE IN THE GLOBAL CARBON CYCLE AND AS A CARBON SINK

- Recognize the role of marine and coastal ecosystems as vital global carbon sinks.
- Develop adequate carbon management schemes for marine and coastal ecosystems.
- Enhance long-term monitoring of carbon in the ocean and support efforts to quantify the ocean's role in the global carbon cycle.

SIGNIFICANTLY REDUCE OTHER HUMAN STRESSORS

- Maintain healthy and recover restore healthy degraded marine and coastal ecosystems.
- Apply an integrated, ecosystem-based coastal and ocean management approach.
- Establish and enforce marine protected areas in all coastal and marine environments.

APPROACH LARGE-SCALE OCEAN FERTILIZATION ACTIVITIES WITH EXTREME CAUTION

- Prohibit large-scale ocean fertilization activities 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.

DEPLOY CARBON CAPTURE AND STORAGE (CCS) WITH EXTREME CAUTION

- Refrain from directly altering ocean chemistry by injecting CO2 into the water column or the deep-sea.
- Refrain from setting investment incentives, which could divert from the development and deployment of other more environmentally friendly mitigation strategies.
- Adopt effective measures and regulations on a global, regional and national basis to ensure that potential risks of CCS schemes have been carefully considered in advance
- Introduce permits for CCS projects based on prior environmental impact assessments, advance notification and consultation and use of independent scientific reviews.
- Require continuous monitoring, reporting and inspection of CCS sites.





INCLUDE THE SHIPPING INDUSTRY IN CO2 EMISSIONS REDUCTION STRATEGIES

- Regulate CO2 emissions generated by oceanic shipping.
- Implement technical and operational measures and management improvements.
- Support and implement longer-term measures of fuel and energy efficient design (e.g., slow-steaming engines or the use of sail- or kite-assisted propulsion).
- Create market-based incentives, as well as mandatory regulations for management plans, efficiency strategies and design indices.
- Increase the availability and use of green energy resources to reduce direct emissions in port areas through connection to shore-based power.

PROMOTE AND INVEST IN ENVIRONMENTALLY SOUND RENEWABLE ENERGY PROJECTS

- Significantly reduce energy demand.
- Make informed decisions regarding the deployment and impacts of marine renewable energy projects
- Use best available information regarding environmental impact assessments.
- Facilitate the development of marine renewable energy resources through regional cooperation (e.g., through grid-sharing between nations).
- Support market feasibility of renewable energy (e.g., guaranteed prices, feed-in tariffs or renewable energy payments).

ACTION RECOMMENDATIONS FOR ECOSYSTEMBASED ADAPTATION

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

Due to the geophysical time lacks of the ocean, 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 adapting to climate change.

What is EbA?

Ecosystem-based adaptation (EbA) is the use of biodiversity and ecosystem services to help people adapt to the adverse effect of climate change.

EbA includes the sustainable management, conservation and restoration of ecosystems so that they can continue providing vital ecosystem services such as storm protection and sustaining livelihoods.

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

USE EBA TO HELP PEOPLE ADAPT TO CLIMATE CHANGE

- Maintain and restore key marine and coastal ecosystems to reduce social and economic vulnerabilities.
- Identify priority areas for protection, restoration, and management by using regional marine assessments, spatial mapping tools and other visualization tools.
- Increase ecosystem resilience and ensure continued provision of ecosystem services by reducing other human stressors on the marine environment [such as pollution, destructive fishing practices, habitat destruction and unsustainable coastal development.]
- Protect natural buffers and plan for inward migration of coastal ecosystems such as mangroves or wetlands.
- Integrate the full suite of EbA actions into poverty reduction and sustainable development plans and strategies.

CONDUCT VULNERABILITY ASSESSMENTS

- Obtain information regarding the relative magnitude of social and environmental costs of climate change and determine the urgency with which EbA strategies should be implemented.
- Develop EbA plans with properly targeted scenarios and strategies and prepare for adaptive management responses.

INCLUDE EBA STRATEGIES IN RISK MANAGEMENT PLANS

- Maintain and restore natural infrastructures, such as mangrove forests, coral reefs and sand dunes, to reduce human vulnerability e.g., to storm events.
- Introduce benefits (e.g., subsidies) for development projects that utilize EbA coastal protection measures.
- Eliminate subsidized insurance and other benefits for development projects that alter natural systems to an extent that increases risk.
- Integrate EbA strategies into the policies of regional and international development banks to ensure adequate implementation and funding of EbA.



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.
- 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.

CREATE COMPREHENSIVE NETWORKS OF 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.
- Encourage connectivity synergies between coastal and marine ecosystems by protecting ecological corridors
- Establish "Predictive Protected Areas," which provide some level of protection for areas expected to be 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.

STRENGTHEN AND DEVELOP LONG-TERM MONITORING AND RESEARCH PROGRAMS

- Ensure long-term monitoring to allow for adaptive management actions.
- Incorporate socio-economic aspects 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.

OCEAN ACIDIFICATION AND OCEAN WARMING

The ocean, marine and coastal ecosystems sustain life supporting systems on earth by cycling oxygen and carbon dioxide, regulating climate and temperature, and providing millions of people with food and livelihoods. These benefits and services which humans derive from marine and coastal ecosystems are however deeply in jeopardy.

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

WHY DOES IT MATTER?

1. The ocean's capacity to store carbon emissions is decreasing. This leaves more carbon in the atmosphere and requires more significantCO2 mitigation actions in order to lower the impacts of climate change.
2. Important planktonic primary producers will be affected by ocean acidification which can be expected to resonate throughout entire food webs and marine ecosystems. Ocean acidification will have an indirect effect on commercially viable species by reducing its food supply.
3. Ocean acidification has increased by 30% since the beginning of the industrial revolution and the rate of acidification is expected to accelerate in the coming decades.

OCEAN ACIDIFICATION

Atmospheric CO2 dissolves in the ocean and reduce its pH level

As atmospheric CO2 increases

Ocean acidity increases

CLIMATE REGULATION

The ocean plays a critical role in the global carbon cycle, especially in helping regulate the amount of CO2 in the atmosphere.

The continued uptake of CO2 will lead to a reduced global capacity of the ocean to absorb carbon, leaving more CO2 in the atmosphere.

ECOSYSTEMS

Ocean acidification will negatively impact many marine organisms and ecosystems

Impacts include:

- Reduced ability of many key marine organisms such as corals, planktons 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

SYNERGISTIC EFFECTS

Rising sea temperatures, increased storm intensity, changing weather patterns and ocean acidification do not operate in isolation but are impacting the marine environment in multiple 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 through heat storage, transportation of heat around the globe, wind, evaporation and precipitation patterns, and freezing and thawing in Polar Regions.

The continued warming of the ocean will increase the intensity of extreme weather events and will/ could provoke changes in ocean currents.

ECOSYSTEMS

Ocean warming will negatively impact many marine organisms and ecosystems.

Impacts include:

- Increased stratification
- Changes in the geographical ranges of marine species
- Changes in diversity and abundance of certain marine organisms
- Increased exceeding? of thermal thresholds

SEA-LEVEL RISE

As water warms, it expands, and the ocean surface rises. Melting inland-glaciers and sea-ice.

OTHER HUMAN STRESSORS

Climate change and ocean acidification are also interacting with other human stressors on the marine environment and exacerbating ecosystem degradation. Marine environments which are subject to stress from local and regional factors such as overfishing, pollution, declining water quality and habitat destruction are more likely to show less resilience in face of climate change and ocean acidification.

WHY DOES IT MATTER?

1. More severe extreme weather events will endanger coastal populations and damage coastal infrastructure.
2. Instabilities in the ocean currents caused by climate change could lead to major shifts in regional climate and weather patterns and human migrations in the future.
3. Ocean stratification will impede the mixing of ocean layers and hence trap valuable nutrients necessary for high ocean productivity.
4. The permanent migration of species to higher latitudes and deeper depths could provoke changes in local availability, endangering food supply and altering traditional fishing grounds and rights.
5. Impacts on primary producers such as phytoplankton can cause changes in species composition and biomass in these communities and could affect all levels of the marine food web.
6. Some marine organism will come close to or over irreversible thresholds near the physiological limit of their temperature range (e.g. coral bleaching). Many of the remaining reefs may be lost over the next 20 to 40 years, jeopardizing livelihoods structures and increasing the vulnerability to storms events.
7. Rising sea-levels are increasing beach erosion and saltwater intrusion. This will jeopardize shore protection and coastal infrastructure, impact human health, and trigger migration.

Healthy ecosystems play a crucial part for mitigation and adaptation strategies. Healthy marine ecosystems are able to sequester more carbon than degraded system and at the same time they help people adapt to a changing climate. Undamaged and restored ecosystems will continue to provide ecosystem services and exhibit higher resilience to other problems. It is therefore essential to actively reduce destructive coastal and marine practices and implement conservation initiatives which are focusing on maintaining a functioning environment for the future.

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 peoples obtain 100% of their animal protein from its waters. Regardless of where we reside, however, we depend on healthy ocean ecosystems and the services that they provide.

The ocean is the life support system for our planet.

CHANGING OCEAN – CHANGING CLIMATE

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, as well as gas storage and exchange (including CO2).

The ocean has a natural ability to buffer and be in balance with the atmosphere. Changes in the ocean-atmosphere coupled climate system could have significant impacts on the regional climate systems, including new current, wind, and precipitation patterns as well as increased ocean stratification – thereby 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 the ocean currents caused by climate change could lead to major shifts in regional climate and weather patterns and human displacement in the future.

Changing precipitation patterns, for example, 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.

CLIMATE CHANGE INDUCED MIGRATION

People are already losing their homes due to the current impacts of climate change. Continuous sea-level rise and increased storm intensity will force the flight of hundreds of millions of people from low-lying delta areas, coastal or island nations. Some places may even become uninhabitable within the next 50 years due to climate change, threatening the existence of entire sovereign countries.

For example, small island states such as Tuvalu, Kiribati, and the Maldives lie less than one to two meters above current sea level. Rising sea-level and extreme weather events cause salination of soils and shallow freshwater supplies, triggering severe health issues, rendering cultivation almost impossible and leading to considerable river loss of farmland, properties and human lives. In extreme weather events, some islanders are left with nowhere to hide or evacuate.

The relocation of entire communities is also occurring in the Arctic region. Sea-level rise, reduced ice sheets, thawing permafrost, and increased coastal erosion are altering the arctic shorelines. This undermines foundations for housing, infrastructure, and water systems. Without the protection of adequate sea-ice coverage, high storm surges may reach the shore and endangered lives and properties.

CLIMATE CHANGE IMPACTS ON HUMAN HEALTH

The impacts of climate change on human health are a primary concern. Direct stressors such as storm events, flooding, and severe winds can result in the damage of private property, the malfunctioning of public sanitation services, and the salination of public fresh water supply. The disturbance of ecosystems on which people depend on or the conflict over diminished resources will lead to malnutrition and alterations to food habits. Especially developing countries which heavily rely on the ocean for their basic protein needs will face problems of availability and quality of fish for food.

Ecosystem-based Adaption (EbA) is a vital strategy for reducing climate change impacts on human health. It is important to enhance the capacity and resilience of ecosystems to act as natural risk reduction mechanisms by restoring ecosystems, protecting natural buffers and by reducing other human stressors. For example, protecting and restoring mangroves and coral reefs will help reduce the impacts of storm events on coastal communities. The restoration of watersheds and wetlands contributes to the natural filtering of water being released into the ocean.

More evidence is emerging that climate change has an impact on the frequency, duration and geographical range of infectious disease patterns and harmful algal blooms (HABs). Human exposure to toxins produced by HABs cause illness and can be fatal. Toxic algal incidents negatively impact marine ecosystems and fish populations, as well. The impacts of HABs can be reduce through public health surveillance, HAB monitoring and prediction of HAB risks, event response strategies, education and information to the public to prevent human exposure.

IN NUMBERS:

- The oceamn covers more than 70%of our planet.
- Less than one percent 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 provide nearly three billion people with at least 15% of their animal protein.
- 400 million people obtain more than half of their animal protein from fish and shellfish.
- It is estimates that by 2050, adverse effects associated with global climate change will result in the displacement of between 50 and 200 million people globally.
- It is predicted that 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 the coming decades.
- Many of the currently remaining coral reefs may be lost to coral bleaching over the next 20 to 40 years
- 70% of known cold-water stony coral ecosystems will no longer be able to maintain calcified skeletal structures by 2100.
- Mangroves have been reduced to less than 50% of their historical cover.
- Land-based sources account for approximately 80% of marine pollution globally.risks, event response strategies, education and information to the public to prevent human exposure.

INVEST IN THE OCEAN NOW!

THE COSTS OF POLICY INACTION

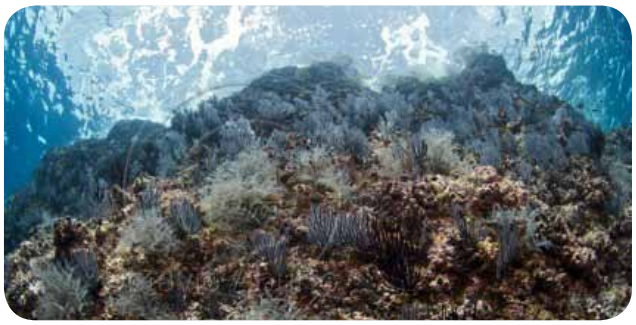
Several studies have highlighted that the economic damage resulting from future climate change will be much higher than the costs for current climate change mitigation and adaption actions. Although it is extremely difficult to present exact economic numbers on the costs of inaction, they will be substantial.

Many reports outline the value that ocean economic activities (e.g., tourism and recreation, transportation, living and mineral resource extractions) contribute to both national economies and foreign exchange receipts, government tax revenues and employed workforce. In the U.S., for example, the ocean economy is responsible for the creation of over 2.3 million jobs and contributes over $138 billion to the nation's GDP. The fisheries sector as one of the various ocean economic activities in Cambodia, the Maldives and Kiribati contributes more than 10% to each of those countries' national GDPs.

Governments cannot afford to ignore proper management and conservation strategies or overlook nature-based solutions for climate change mitigation and adaptation strategies. Investments in the management, conservation and protection of ecosystems and their services will not only help to build social resilience to climate change, but it 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, 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 VALUATION OF ECOSYSTEM SERVICES

Despite the role of coastal and marine ecosystems in supporting economic development and social welfare, particularly in developing countries, current analysis of market activity does not consider all of these contributing factors. Indirect ecosystem services do not send price signals to markets and are therefore often not addressed in policy and business decisions that affect how ocean resources and services are used or misused.

While some of the value of intact ecosystems can be captured by the markets, the loss of entire ecosystems due to climate change and other impacts are difficult to unambiguously and wholly calculate in economic terms. 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, and what is at risk if those ecosystems continue to degrade or are lost permanently. The dialogue and collaboration amongst economists and natural scientists should be increased to provide more accurate policy-relevant valuation of ecosystem services.

Payment for Ecosystem Services (PES) schemes provide for example a mechanism for capturing some of the value well-functioning ecosystems provide, and thereby, aid in their protection. While ecosystem valuation informs policy development and can generate political and financial incentives, PES operationalizes the valuation efforts and delivers innovative and sustainable financing sources to the conservation arena.

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Extended document with full scientific references and review
A more detailed version of "Oceans and Climate Change –Tools and Guidelines for Action" supported by scientific references can be consulted and downloaded at www…..

About IUCN

IUCN, the International Union for Conservation of Nature, helps the world find pragmatic solutions to our most pressing environment and development challenges by supporting scientific research; managing field projects all over the world; and bringing governments, NGOs, the UN, international conventions and companies together to develop policy, laws and best practice.
The world's oldest and largest global environmental network, IUCN is a democratic membership union with more than 1,000 government and NGO member organizations, and almost 11,000 volunteer scientists and experts in some 160 countries. IUCN's work is supported by over 1,000 professional staff in 60 offices and hundreds of partners in public, NGO and private sectors around the world. IUCN's headquarters are located in Gland, near Geneva, in Switzerland.

About the Global Marine Programme

Working alongside the world's leading marine experts, IUCN's Global Marine Programme pioneers pragmatic solutions for our most pressing marine environmental challenges. The 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
Further details on GMP's work can be found at www.iucn.org/about/work/programmes/marine/

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