

SUMMARY

The World's oceans play a crucial role for life on the planet. Healthy seas and the services they provide are key to the future development of mankind. Our seas are highly dynamic, structured and complex systems. The seafloor consists of vast shelves and plains with huge mountains, canyons and trenches which dwarf similar structures on land. Ocean currents transport water masses many times larger than all rivers on Earth combined.

In this report, the locations of the most productive fishing grounds in the World – from shallow, coastal waters to the deep and high seas – are compared to projected scenarios of climate change, ocean acidification, coral bleaching, intensity of fisheries, land-based pollution, increase of invasive species infestations and growth in coastal development.

Half the World catch is caught in less than 10% of the ocean

Marine life and living resources are neither evenly nor randomly distributed across the oceans. The far largest share of marine biodiversity is associated with the sea bed, especially on the continental shelves and slopes. Seamounts, often rising several thousand meters above their surroundings, provide unique underwater oases that teem with life. Environmental parameters and conditions that determine the productivity of the oceans vary greatly at temporal and spatial scales. The primary and most important fishing grounds in the World are found on and along continental shelves within less than 200 nautical miles of the shores. The distribution of these fishing grounds is patchy and very localized. Indeed more than half of the 2004 marine landings are caught within 100 km of the coast with depths generally less than 200 m covering an area of less than 7.5% of the world's oceans, and 92% in less than half of the total ocean area. These treasure vaults of marine food play a crucial role for coastal populations, livelihoods and the economy.

Whether they will provide these functions and services in the future depends on needed policy changes and the continuation of a number of environmental mechanisms to which marine life has evolved and adapted. These natural processes include



clean waters with balanced temperature and chemistry regimes as well as currents and water exchanges that provide these areas with oxygen and food, to name just a few. However, there are alarming signals that these natural processes to which marine life is finely attuned are rapidly changing.

With climate change, more than 80% of the World's coral reefs may die within decades

In tropical shallow waters, a temperature increase of up to only 3° C by 2100 may result in annual or bi-annual bleaching events of coral reefs from 2030–2050. Even the most optimistic scenarios project annual bleaching in 80–100% of the World's coral reefs by 2080. This is likely to result in severe damage and wide-spread death of corals around the World, particularly in the Western Pacific, but also in the Indian Ocean, the Persian Gulf and the Middle East and in the Caribbean.

Ocean acidification will also severely damage cold-water coral reefs and affect negatively other shell-forming organisms

As CO₂ concentrations in the atmosphere increase so does ocean assimilation, which, in turn, results in sea water becoming more acidic. This will likely result in a reduction in the area

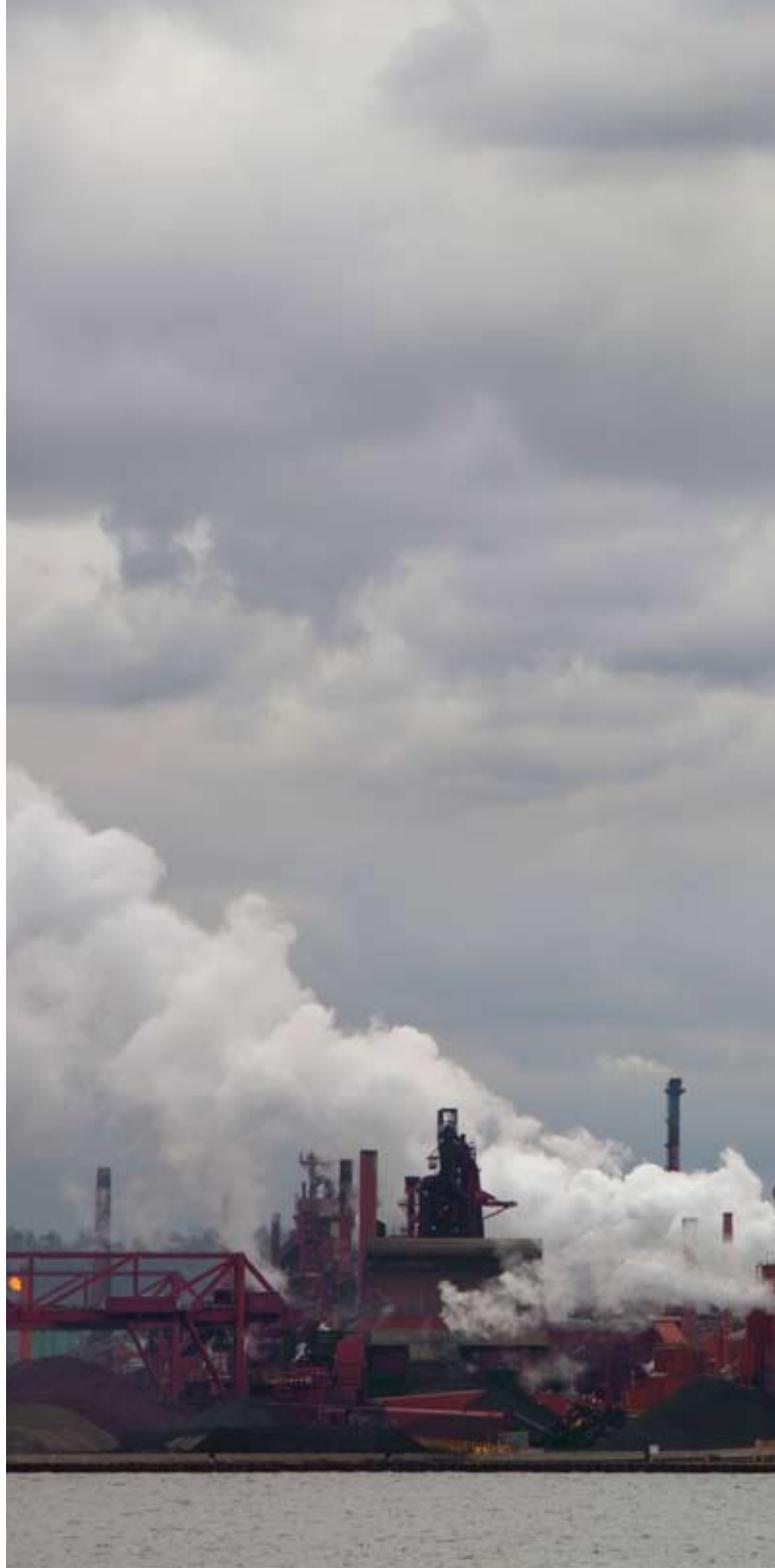
covered and possible loss of cold-water coral reefs, especially at higher latitudes. Besides cold-water corals, ocean acidification will reduce the biocalcification of other shell-forming organisms such as calcareous phytoplankton which may in turn impact the marine food chain up to higher trophic levels.

Coastal development is increasing rapidly and is projected to impact 91% of all inhabited coasts by 2050 and will contribute to more than 80% of all marine pollution

Marine pollution, more than 80% of which originates from land-based sources, is projected to increase, particularly in Southeast and East Asia, due to rising population and coastal development. Increased loads of sediments and nutrients from deforestation, sewage and river run-off will greatly diminish the resilience of coral reefs. The effects of pollution are exacerbated by the destruction of mangroves and other habitats due to the rapid construction taking place on coastlines. As much as 91% of all temperate and tropical coasts will be heavily impacted by development by 2050. These impacts will be further compounded by sea level rise and the increased frequency and intensity of storms that easily break down weakened or dead corals and are likely to severely damage beaches and coast lines.

Climate change may slow down ocean thermohaline circulation and continental shelf “flushing and cleaning” mechanisms crucial to coastal water quality and nutrient cycling and deep-water production in more than 75% of the World’s fishing grounds

Of major concern is that many of these productive fishing grounds depend extensively upon sea currents for maintaining life cycle patterns for the sustainable production of fish and other marine life. Large scale water exchange mechanisms, which periodically “flush and clean” continental shelf areas, are observed in and near at least ca. 75% of all the major fishing grounds. These mechanisms, however, depend entirely on





cooler and heavier seawater sinking into the deep sea, often using and carving channels and canyons into the continental shelf. New research suggests that while climate change may not necessarily stop the major thermohaline currents, climate change may potentially reduce the intensity and frequency of the coastal flushing mechanisms, particularly at lower to medium latitudes over the next 100 years, which in turn will impact both nutrient and larval transport and increase the risk of pollution and dead zones.

Increased development, coastal pollution and climate change impacts on ocean currents will accelerate the spreading of marine dead zones, many around or in primary fishing grounds

The number of dead zones (hypoxic or oxygen deficient areas) increased from 149 in 2003 to over 200 in 2006. Given their association with pollutants from urban and agricultural sources, together with the projected growth in coastal development, this number may multiply in a few decades, unless substantial changes in policy are implemented. Most dead zones, a few of which are natural phenomena, have been observed in coastal waters, which are also home to the primary fishing grounds.

Over-harvesting and bottom trawling are degrading fish habitats and threatening the entire productivity of ocean biodiversity hotspots, making them more vulnerable to climate change

Recent studies indicate that fishery impacts in shelf areas may potentially become even worse in deeper water. Due to advances in technology and subsidies, fishing capacity is now estimated to be as much as 2.5 times that needed to harvest the sustainable yield from the world's fisheries. Up to 80% of the world's primary catch species are exploited beyond or close to their harvest capacity, and some productive seabeds have been partly or even extensively damaged over large areas of fishing grounds. With many traditional, shallow fishing grounds depleted, fisheries (especially large industrial vessels/fleets operating for weeks/months at sea) are increasingly targeting deep-water species on the continental slopes and seamounts. Over 95% of the damage and change to seamount ecosystems is caused by bottom fishing, mostly carried out unregulated and unreported with highly destructive gear such as trawls, dredges and traps.

Trawling has been estimated to be as damaging to the sea bed as all other fishing gear combined. Unlike only a decade ago, there are now numerous studies from nearly all parts of the world, documenting the severe long-term impacts of trawling. The damage exceeds over half of the sea bed area of many fishing grounds, and worse in inner and middle parts of the continental shelves with particular damage to small-scale coastal fishing communities. Indeed, while very light trawling may be sustainable or even increase abundance and productivity of a few taxa, new studies, including data from over a century ago, clearly indicate damage to the sea bed across large portions of the fishing grounds, and at worst reductions in pristine taxa of 20–80% including both demersals and benthic fauna. Unlike their shallow water counterparts, deep sea communities recover slowly, over decades and centuries, from such impacts. Some might not recover at all if faced with additional pressures including climate change and might lead to a permanent reduction in the productivity of fishing grounds. There are now discussions ongoing within several bodies including the FAO on developing better international guidelines for the management of deep-sea fisheries in the high seas, but substantial action is urgently needed given the cumulative threats that the oceans are facing.





Primary fishing grounds are likely to become increasingly infested by invasive species, many introduced from ship ballast water.

The vulnerability of impacted ecosystems to additional stresses is also demonstrated by the increase of invasive species infestations that are concentrated in the same 10–15% of the World's oceans. Heavily disturbed and damaged marine areas are more likely to have a higher vulnerability to infestations brought in by ships plying the World's oceans despite recommendations in many areas for mid-ocean exchange of ballast water. Geographical distribution of invasive species suggests a strong relationship between their occurrence and disturbed, polluted and overfished areas and in particular the location of major shipping routes at a global scale. It appears that the most devastating outbreaks of such marine infestations have been brought in along the major shipping routes and primarily established in the most intensively fished and polluted areas on the continental shelves. Growing climate change will most likely accelerate these invasions further.

The worst concentration of cumulative impacts of climate change with existing pressures of over-harvest, bottom trawling, invasive species, coastal development and pollution appear to be concentrated in 10–15% of the oceans concurrent with today's most important fishing grounds

Climate change, with its potential effects on ocean thermohaline circulation and a potential future decline in natural 'flushing and cleaning' mechanisms, shifts in the distributions of marine life, coral bleaching, acidification and stressed ecosystems will compound the impacts of other stressors like over-harvest, bottom trawling, coastal pollution and introduced species. The combined actions of climate change and other human pressures will increase the vulnerability of the world's most productive fishing grounds – with serious ecological, economic and social implications. The potential effects are likely to be most pronounced for developing countries where fish are an increasingly important and valuable export product, and there is limited scope for mitigation or adaptation.

A lack of good marine data, poor funding for ocean observations and an 'out of sight – out of mind' mentality

may have led to greater environmental degradation in the sea than would have been allowed on land.

The lack of marine information and easy observation by humans as land-living organisms, along with insufficient funds for monitoring, may result in these and other pressures to progress farther than anything we have yet seen or would have permitted without intervention on land, even though the oceans represent a significant share of global economies and basic food supply. Lack of good governance, particularly of the high seas, but also in many exclusive economic zones (EEZs) where the primary focus is economic gain, and has resulted in limited flexibility or incentive to shift to ecosystem based management. The potential for climate change to disrupt natural cycles in ocean productivity, adds to the urgency to better manage our oceans. The loss and impoverishment of these highly diverse marine ecosystems on Earth and modification of the marine food chain will have profound effects on life in the seas and human well-being in the future.

Substantial resources need to be allocated to reducing climate and non-climate pressures. Priority needs to be given to protecting substantial areas of the continental shelves. These initiatives are required to build resilience against climate change and to ensure that further collapses in fish stocks are avoided in coming decades.

Urgent efforts to control accelerating climate change are needed, but this alone will not be sufficient. A substantially increased focus must be devoted to building and strengthening the resilience of marine ecosystems. Synergistic threats and impacts need to be addressed in a synergistic way, via application of an ecosystem and integrated ocean management approach. Actions for a reduction of coastal pollution, establishment of marine protected areas in deeper waters, protection of seamounts and parts (likely at least 20%) of the continental shelves against bottom trawling and other extractive activity, and stronger regulation of fisheries have all to go hand in hand. Unless these actions are taken immediately, the resilience of most fishing grounds in the world, and their ability to recover, will further diminish. Accelerating climate change and in-action risks an unprecedented, dramatic and wide-spread collapse of marine ecosystems and fisheries within the next decades.