Pushed to the brink

The oceans and climate change

greenpeace.org

GREENPEACE

Defending Our Oceans

For more information contact:
enquiries@int.greenpeace.org

Printed on 100% recycled
post-consumer waste with
vegetable based inks.

JN 130

Cover image:
Healthy corals and sponges at Apo Island
Marine Reserve, Philippines.
©Greenpeace / G Newman

Published in July 2008
by Greenpeace International
Ottho Heldringstraat 5
1066 AZ Amsterdam
The Netherlands
Tel: +31 20 7182000
Fax: +31 20 5148151

greenpeace.org

©GREENPEACE / V LEE HUNTER

The world's oceans are under immediate and significant threat from overfishing. 77% of all fish stocks are now either fully or over-exploited

Introduction

Without our oceans, life on Earth would not be possible. They produce and regulate most of the world's oxygen, water and water supply cycles; drive and moderate the world's climate and weather; provide a substantial amount of the world's nutrient cycling; stabilise biota and biological communities including pests and disease; support most of the world's biological diversity and feed humans – to name but a few important functions.
It is a matter of grave concern, therefore, that the oceans are being systematically degraded and are in decline.
Already subjected to multiple human-induced stressors, most seriously overfishing, the resilience of the oceans and their consequent ability to adapt to change is decreasing. Yet it is this very resilience that scientists argue is vital if the oceans are to survive the onslaught of global climate change.

Current threats

The most immediate and significant threat to the oceans is overfishing. The demand for fish is exceeding the oceans' ecological limits with devastating impacts on marine ecosystems. Scientists are warning that overfishing results in profound changes in our oceans, perhaps permanently.

Despite some alterations to the way fisheries are managed, there is little ground for optimism; 77% of all fish stocks are now either fully or over-exploited[1]; fishermen are bringing home smaller and smaller catches despite technological advances; fish-size, abundance and genetic diversity has plummeted; high-value species are being replaced by so-called "trash" fish; and habitat degradation is widespread and increasing[2]. Destructive practices and overfishing have diminished the sea's ability to renew its resources, with consequences for the more than one billion people in the world who rely on fish as their primary source of protein.

The reality of modern fishing is an industrialisation that far outstrips nature's ability to replenish. Ships operate as floating factories, containing fish processing and packing plants, huge freezing systems and powerful engines to drag enormous fishing gear through the oceans – everything required to suck as much fish out of the oceans as quickly as possible and to despatch it for consumption.

This wholesale damage and destruction is compounded by many other stressors exerted on the ocean from pollution to extraction. The cumulative result is that the resilience of the oceans – both individually and as a global network providing major services to the planet – is degenerating.

Climate change will only make this situation worse.

Climate change and the world's oceans

Climate change is already harming people and ecosystems. Its reality can be seen in disintegrating polar ice, thawing permafrost, dying coral reefs, rising sea levels, changing ecosystems and increasingly intense extreme weather events. It is not just the scientists who are witnessing these changes; from Inuit in the far north to islanders near the equator, people are already struggling with the impacts of climate change. Internationally the debate is no longer about whether or not the impacts will be serious but about how to avoid the most dangerous impacts of climate change and how to adapt to and manage those already occurring.

We have a tendency to think of climate change in terms of its impacts on land but it has multiple effects on the oceans, affecting their ability to function. These include:

Rising temperatures

- The distribution of plankton and marine productivity in the oceans is likely to shift with projected changes in the sea-surface temperature, together with wind speed, nutrient supply and sunlight, with consequences for the entire marine food-web, including the abundance and distribution of commercial species[3].
- Entire species of marine animals and fish will die out because they are unable to survive in warmer waters.
- Whales and dolphins strand themselves in high temperatures and the great whales risk losing their feeding grounds in the Southern Ocean around Antarctica because of melting and the collapse of ice shelves.
- An increasing occurrence of disease in marine animals has also been found to be linked to rising ocean temperatures.

Turning sour

- The oceans naturally absorb carbon dioxide (CO_2) from the atmosphere. To date they have absorbed approximately 70% of the human-created carbon overload, thus slowing the rate of climate change, but this has led to changes in the chemical balance of sea water, making it less alkaline (that is, with a lower pH), a process called 'acidification'. The oceans will continue absorbing excess CO_2 to their detriment and with increasing shifts in the pH balance of the oceans. Ocean acidification is not strictly an effect of climate change, but rather an additional consequence of rising atmospheric CO_2 levels[4,5].
- Acidification of the oceans, even long before the water actually becomes acidic (that is with a pH lower than 7), is detrimental to a wide range of marine organisms, such as phyto- and zoo-plankton, molluscs and corals, which rely on a process of calcification to produce external or internal skeletons made from calcium carbonate[6]. Increased acidity makes calcification more difficult and energy intensive and can ultimately lead to the dissolution of carbonate structures. The wider implications for biodiversity and ecosystem processes are only now beginning to be understood.
- Changes to the ocean's salinity from melting Arctic ice and/or increased precipitation could also switch off, slow down or divert ocean currents, bringing about a dramatic disruption around the globe.

Changing currents

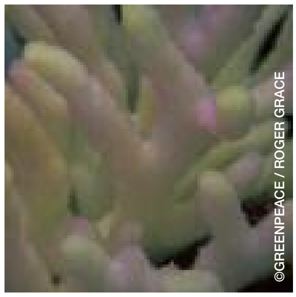
- The water in our world's oceans is always moving – pulled by tides, blown by waves and slowly circulating around the globe by the force of the Great Ocean Conveyor Belt (also called thermohaline circulation). The Conveyor is powered by differences in water temperature and salinity and performs a range of important functions. The Gulf Stream, for example - one of its better known parts - carries warm water north from the tropics, and is what gives Europe its relatively warm climate and plays a role in moderating the global climate. The Conveyor also provides an upwelling of bottom-ocean nutrients and increases the oceanic absorption of carbon dioxide.
- Rising temperatures and changing salinity patterns are leading to changes in these currents. For example, increasing freshwater runoff into the Arctic Ocean north of Europe and Russia is weakening the Gulf Stream. In November 2006, scientists reported that the Gulf Stream appears to have weakened by 30% in just 12 years . Recent studies warn that we may already have evidence of a slower Conveyor circulation over the Scotland-Greenland deep ocean ridge.
- Examination of ice cores from both Greenland and Antarctica has shown that abrupt climate change incidents in the distant past have lead to changes in the Conveyer circulation. Such changes are certain to affect all life, terrestrial as well as marine, since the services which the Conveyer performs for the whole planet will be disrupted with consequences we can but poorly understand at this point.

Shrinking habits

- Reductions in Arctic and Antarctic sea-ice could alter the seasonal distributions, geographic ranges, migration patterns, nutritional status, reproductive success and ultimately the abundance of many marine mammals that depend on these ecosystems.
- Arctic sea-ice has decreased by about 8% over the past 30 years and some models indicate a complete ice-free summer Arctic Ocean in the latter half of this century[8]. Phytoplankton grows under sea-ice. A reduction in sea-ice implies a reduction in phytoplankton. Phytoplankton feeds small crustaceans including krill, so any reduction in phytoplankton implies a subsequent reduction in krill. In turn, krill feeds many marine species and is at the centre of the region's food web.

Rising sea levels

- With rising sea levels there is an increased possibility that important habitats such as coastal meadows and lagoons will be squeezed or completely lost. In addition, increasingly destructive storms and hurricanes threaten many coastal areas.
- A global average sea level rise between 9 and 88 cm (3.5 and 34.6 inches) is expected over the next hundred years, as a result of the greenhouse gasses we have emitted to date and likely future emissions.
- This rise will come in roughly equal measure from melting ice and thermal expansion of the oceans (water expands as it heats up). Even this modest rise will wreak havoc. Coastal flooding and storm damage, eroded shorelines, saltwater contamination of freshwater supplies, the flooding of coastal wetlands and barrier islands, and an increase in salinity are all realities of even a small amount of sea level rise, affecting millions of people. Resources critical to island and coastal populations – including beaches, fresh water, fisheries, coral reefs and atolls and wildlife habitat - will be at risk.



An example of coral bleaching from the Great Barrier Reef.

- Only four years ago, it was commonly accepted that the West Antarctic ice sheet was stable, but unexpected melting in the region is causing scientists to rethink this assumption. Potentially, the West Antarctic ice sheet could contribute an additional six metres to sea level rise. Although the chances of this are considered low in the United Nations Intergovernmental Panel on Climate Change (IPCC) Third Assessment report, recent research indicates new evidence of massive ice discharge from the ice sheet. The entire Antarctic ice sheet holds enough water to raise global sea levels by 62 metres.

- In July 2005, scientists aboard the Greenpeace ship Arctic Sunrise made a shocking discovery – evidence that Greenland's glaciers are melting at an unprecedented rate. Findings indicated that the Kangerdlugssuaq Glacier on Greenland's east coast could be one of the fastest-moving glaciers in the world, with a speed of almost 14 kilometres per year. In addition, the glacier unexpectedly receded approximately five kilometres since 2001 after maintaining a stable position for the past 40 years. Greenland's massive ice sheet locks up more than 6% of the world's fresh water supply and it is melting much faster than expected. If Greenland were to fully melt, it would cause sea levels around the globe to rise by nearly 6 metres. Even measurements of 1.25 to 1.5 metres of sea level rise could mean that locations as diverse as New York and Bangladesh will experience flooding.

- The alarming retreat of the Kangerdlugssuag Glacier suggests that the entire Greenland ice sheet may be melting far more rapidly than previously believed. All current scientific forecasts for global warming have assumed slower rates of melting. This new evidence suggests that the threat of global warming is much greater and more urgent than previously believed.

The IPCC warned in 2001 that climate change will *"affect the physical, biological and biochemical characteristics of the oceans and coasts", with "significant feedback on the climate system"* [9]. Organisms in coastal zones and enclosed seas would be most at risk from climate change.

In February 2007, the IPCC revealed that our oceans had absorbed more than 80% of the heat added to the climate system and that average sea temperatures, as a result, had increased to depths of at least 3,000 metres[10]. At current levels, the ocean will continue to heat up for *"more than a millennium"*.

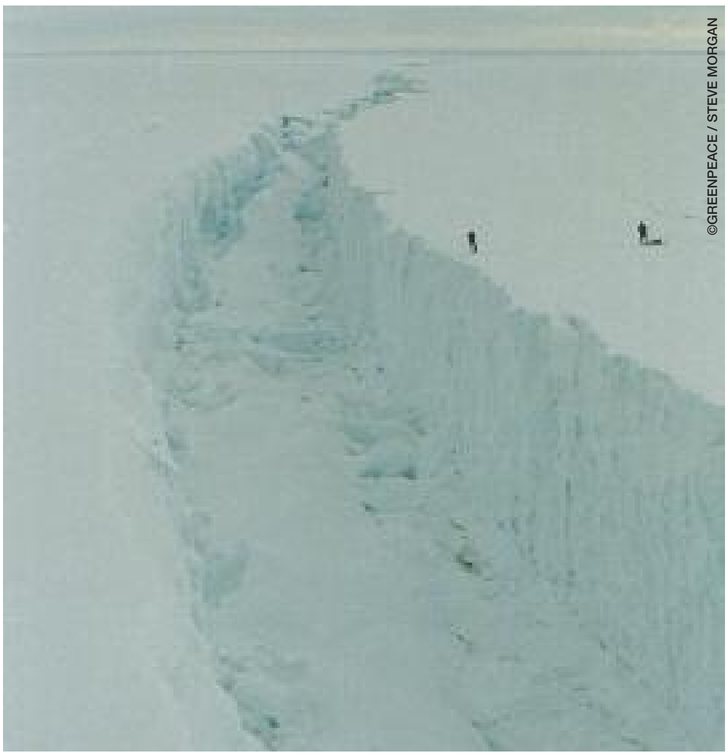
This will inevitably lead to changes in our oceans and those changes are likely to be highly complex, from shifts in sea temperature, sea level and currents to the very chemistry of the sea water itself. Moreover, negative feedback between climate change and other human activities, particularly fishing pressure, will likely exacerbate the climate-induced changes to marine ecosystems.

The Secretariat of the Convention on Biological Diversity (CBD) advised that *"genetically-diverse populations and species-rich ecosystems have a greater potential to adapt to climate change"*[11]. To help reduce the negative impacts of global warming, it recommends that fishing nations reduce pressure on fisheries and associated ecosystems.

The urgency of the situation was starkly illustrated in November, 2006, when an international group of scientists, led by Professor Boris Worm, showed that the loss of marine biodiversity is drastically reducing the ocean's ability to produce seafood, resist diseases, filter pollutants and rebound from stresses such as overfishing and climate change. The team went on to warn that the consequences of biodiversity loss are felt in terms of the structure and functioning of ecosystems, including their interactions with the water, carbon, nitrogen and other major bio-geochemical cycles[12].

In short, the experts warn that we have eroded the ocean's ability to cope with and mitigate the consequences of climate change. They recommend that we reduce our exploitation levels of marine fish and other maritime activities in order to improve the resilience of our oceans and ultimately safeguard their role in stabilising the climate and maintaining life on earth.

We need to reduce all the pressures exerted on the oceans in order to give them the best possible chance of withstanding the impacts of climate change, because the Earth cannot survive without the services that the oceans provide. This includes tackling climate change through achieving a peak in global greenhouse gasses by 2015 and more than halving emissions by 2050.



Marine Reserves
Protecting the marine environment from climate change

An ecosystem approach

The growing understanding that conventional fisheries management is failing and climate change impacts are growing has prompted widespread agreement on the need to adopt an approach to the management of fisheries and other human activities which addresses the whole ecosystem. Scientists and politicians agree that it is necessary to move away from conventional, single-stock management towards what is called the 'ecosystem-based approach' and this is reflected in a series of political commitments at national, regional and international level.

But these commitments have not resulted in effective implementation, leaving the oceans in their current vulnerable state.

Radical action is needed to address the threats facing the oceans and protect their vital functions, taking into account the complex interactions of all the ecosystems of the marine realm and of all the oceans, which combine to provide functions for the single largest ecosystem of all – planet Earth.

This is possible with a twofold approach whereby human activities are managed sustainably and areas of the oceans are set aside as marine reserves.

Implementation

To implement this ecosystem approach requires a management strategy that:
- goes beyond a single or multi-species approach by considering the ecosystem as a whole;
- is aimed at protecting biodiversity and recovering ecosystems, not least with the aim to improve their resilience to global climate change;
- avoids over-harvesting and ecosystem modifications;
- is based on the precautionary principle – i.e. conservation measures are taken even in the absence of full knowledge of the activities, impacts and ecological responses to these impacts;
- focuses on the 'upstream' control of human activities rather than on the control of impacts or ecosystems;
- is robust even in the light of uncertainties and management oversight; and
- can be applied with immediate effect.

Respite and recovery

A marine reserve is an area closed to all extractive uses, such as fishing and mining, as well as disposal activities. Marine reserves can protect near-pristine ecosystems and offer respite to heavily depleted stretches of ocean, allowing areas to recuperate, recover and ultimately regain some level of natural resilience. They are pockets of protection, scientifically selected and determined, which boost the overall health of the ocean, not just in the immediate area but across the wider oceans.

Scientists believe that marine reserves will enable a rapid and long-lasting increase in abundance, diversity and productivity of organisms and ecosystems and provide a reduced probability of extinction. This will mean that they support and benefit adjacent areas and fisheries outside the reserve because, for example, the fish within the reserves increase in size, population and reproductive capacity and fish, eggs and larvae 'spill-over' into the broader ocean.

The reserves would also benefit highly migratory and endangered species, such as sharks, tuna and billfish, where the reserves are created along important migratory routes - for example, around nursery or spawning grounds or aggregation sites such as seamounts.

Arguably more importantly, the pockets of protection and resilience will buffer the entire oceans network against the impact of climate change.

It is partly with this in mind that networks of marine reserves are proposed that stretch across the globe. There is increasing evidence that such networks will be more effective at buffering environmental variability and providing greater protection for marine communities than single ones. The World Parks Congress recommended in 2003 that at least 20-30% of marine habitats be included in networks of marine reserves.

In 2005, the United Nations Millennium Project called for 10% of the oceans to be covered by marine reserves in the short to medium-term, with a long-term goal of 30%. A review of 40 studies into the coverage that is necessary to achieve conservation and fisheries management goals concludes that 20-50% of the ocean should be protected[13].

Greenpeace advocates that some 40% of marine areas globally should be designated as fully-protected marine reserves. Marine reserves offer the highest level of protection in response to the gravity of the threats our oceans face. Given the level of uncertainty in determining the effectiveness of individual ecosystem-based management measures, the establishment of permanent, legally defined and fully-protected reserves will be a vital component of implementing the ecosystem approach while providing immediate respite and recovery.

We now know that human activity can have serious impacts on the vital forces governing our planet. We have fundamentally changed our global climate and are just beginning to understand the consequences of that.

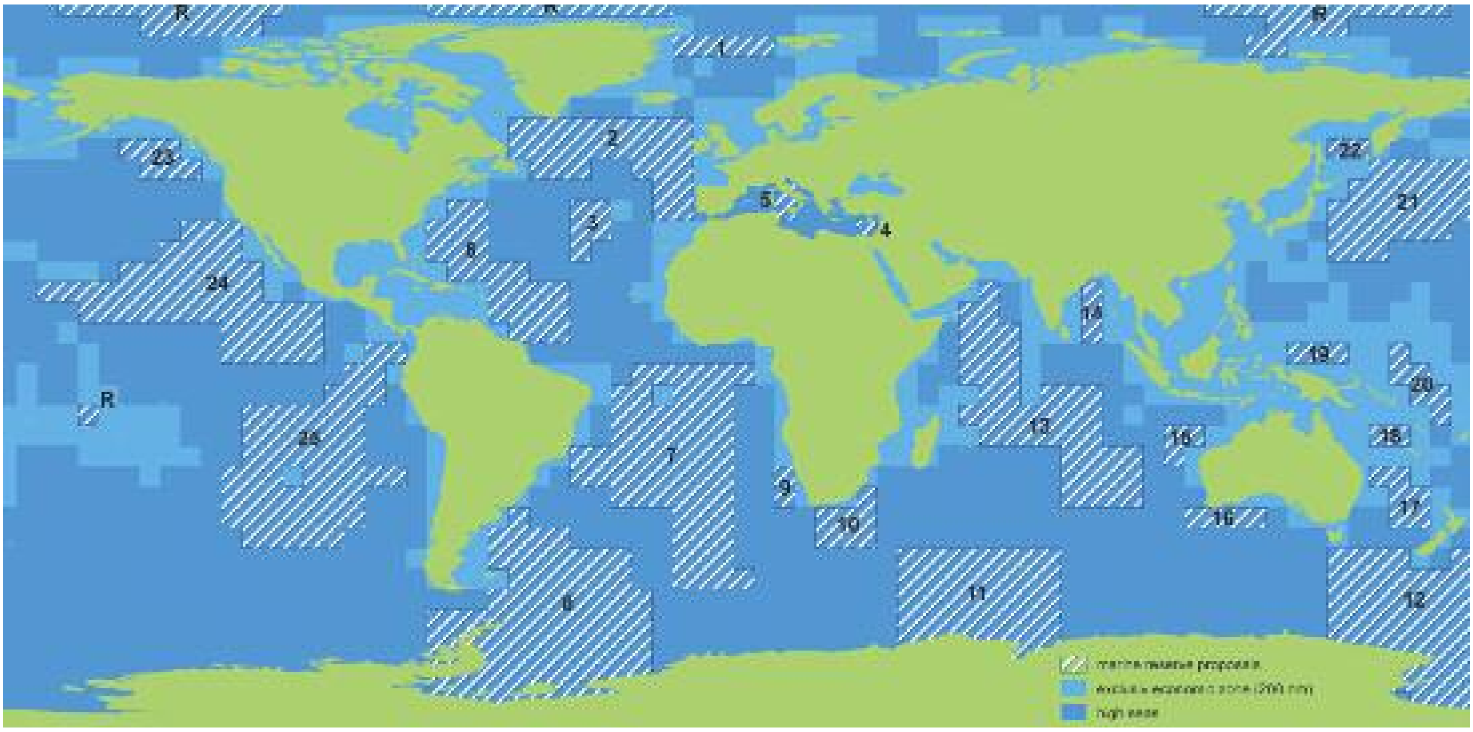
As yet largely unseen, but just as serious, are the impacts we are having on the oceans.

We need to defend our oceans because without them, life on Earth cannot exist.

Dead oceans, dead planet.

Globally more than one billion people depend on seafood as their primary source of protein.

Global network of marine reserves on the high seas as proposed by Greenpeace



Key to proposed marine reserve areas

(1) Greenland Sea
(2) North Atlantic
(3) Azores/Mid-Atlantic Ridge
(4) Eastern Mediterranean
(5) Central Mediterranean
(6) Sargasso Sea/Western Atlantic
(7) South-Central Atlantic
(8) Antarctic-Patagonia
(9) Vema Seamount-Benguela
(10) South Africa-Agulhas Current
(11) Southern Ocean
(12) Southern Ocean- Australia/New Zealand
(13) Central Indian Ocean- Arabian Sea
(14) Bay of Bengal
(15) Northwestern Australia
(16) South Australia
(17) Lord Howe Rise and Norfolk Ridge
(18) Coral Sea
(19) Northern New Guinea
(20) Western Pacific
(21) Kuroshi-Oyashio Confluence
(22) Sea of Okhotsk
(23) Gulf of Alaska
(24) Northeastern Pacific
(25) 0Southeastern Pacific
(marked ‘R’) Representative areas

GREENPEACE

Greenpeace is an independent global campaigning organisation that acts to change attitudes and behaviour, to protect and conserve the environment and to promote peace.

Greenpeace International
Ottho Heldringstraat 5
1066 AZ Amsterdam
The Netherlands
Tel: +31 20 7182000
Fax: +31 20 5148151

Footnotes

1 (FAO (2007) State of the World's Fisheries and Aquaculture. Food and Agriculture Organisation, Rome. http://www.fao.org/docrep/009/A0699e/A0699e00.htm

2 Callum Roberts (1997) Ecological advice for the global fisheries crises. Trends in Ecology and Evolution (12) 1; pp. 35-38

3 IPCC (2001) Climate Change 2001: Impacts, Adaptation and Vulnerability; Chapter 6 Coastal Zones and Marine Ecosystems. http://www.grida.no/climate/ipcc_tar/wg2/index.htm

4 Joint Research Centre of the European Commission (2006) Marine and Coastal Dimension of Climate Change in Europe. A report to the European Water Directors. Produced by the Institute for Environment and Sustainability.

5 This Pörtner, H-O (2006) Auswirkung von Temperaturerhöhung und CO_2-Eintrag auf die marine Biosphäre. WBGU Wissenschaftlicher Beirat der Bundesregierung Globaler Umweltveränderungen.

6 The Royal Society (2005) Ocean acidification due to increasing atmospheric carbon dioxide. Cardiff, UK.

7 Pearce, F (2005) Failing ocean current raises fears of mini ice-age. Nature 438: 655

8 Joint Research Centre of the European Commission (2006) Marine and Coastal Dimension of Climate Change in Europe. A report to the European Water Directors. Produced by the Institute for Environment and Sustainability.

9 IPCC (2001) Climate Change 2001: Impacts, Adaptation and Vulnerability; Chapter 6 Coastal Zones and Marine Ecosystems. http://www.grida.no/climate/ipcc_tar/wg2/index.htm

10 Intergovernmental Panel on Climate Change (2007) The Physical Science Basis – Summary for Policymakers. Contribution of WGI to the Fourth Assessment Report. http://www.ipcc.ch/SPM2feb07.pdf

11 Secretariat of the Convention on Biological Diversity (2003) Interlinkages Between Biological Diversity and Climate Change – Advice on the integration of biodiversity considerations into the implementation of the United Nations Framework Convention on Climate Change and its Kyoto Protocol. CBD Technical Series No. 10.

12 Worm B, Barbier EB, Beaumont N, Duffy JE, Folke C, Halpern BS, Jackson JBC, Lotze HK, Micheli F, Palumbi SR, Sala E, Selkoe K, Stachowicz JJ, Watson R (2006) Impacts of biodiversity loss on ocean ecosystem services. Science 314:787-790. http://myweb.dal.ca/bworm/Worm_etal_2006Science.pdf

13 Gell FR and Roberts CM (2003) Benefits beyond boundaries: the fisheries effects of marine reserves. Trends in Ecology and Evolution 18: 448-455