WWF

FACTSHEET

2018

CLIMATE CHANGE: OCEAN AND FISHERIES

OUR CHANGING OCEAN

The ocean provides livelihoods for millions of people, and food for billions. It supports amazing biodiversity and it regulates our climate. It produces oxygen and absorbs carbon dioxide. Ours is a blue planet, and we all depend on a healthy ocean.

But our ocean is in trouble, and we are responsible. Since 1970, marine vertebrate populations have fallen by more than a half, and the crisis is getting worse. Overfishing, pollution and habitat destruction have had a devastating impact on marine ecosystems and the life they support; and now these pressures are being amplified by another human factor: climate change.

Rising levels of CO_2 in the atmosphere, and the higher temperatures it brings, are changing our ocean. The waters of the world are warming and becoming more acidic, and the damage is already visible all around us.

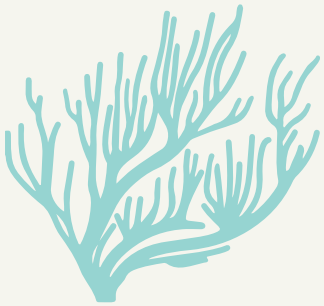
2016 saw the highest ocean temperatures on record, as well as the highest levels of CO_2[1]. Arctic sea ice receded further than ever before. From rising seas and dying coral to extreme weather and collapsing food webs, change is happening right now.

This brochure explains what climate change means for our ocean, and what that in turn means for us.

HOW THE OCEAN IS CHANGING: THE PHYSICAL AND CHEMICAL REALITY OF A WARMING WORLD

Climate change works in different ways. On the one hand, higher temperatures mean physical changes to the marine environment: warmer water on the ocean surface affects the way water circulates at greater depths and disrupts complex food webs, while changing weather patterns bring more frequent and severe storms with implications for both coastal habitats and fisheries.

Chemically, the ocean is changing at an unprecedented rate by absorbing more CO_2 from the atmosphere, creating a more acidic environment. Many organisms from corals to juvenile fish are struggling to adapt. What's more, warmer seas also hold less oxygen, leading to changes in ecosystems and species populations.



2017

SAW THE HIGHEST OCEAN HEAT CONTENT AND THE HIGHEST SEA LEVEL RISE ON RECORD [1]

OCEAN WARMING

For the last 30 years, the surface layer of the ocean (0-300m) has been getting warmer, although this has taken place at different rates around the world. Unfortunately, ocean warming hotspots are often located in areas where people depend to the greatest extent on fish for food security and livelihoods.

A warmer surface layer means more 'stratification', or layering, in the ocean. In general this means there's less water exchange between the upper (warmer) and lower (colder) layers in the water column, which directly affects nutrients and plankton – and the immense food webs which they support.

SEA LEVEL RISE

As our planet warms, our sea levels are rising from melting glaciers, icecaps and icesheets. Between 1901 and 2010, global Sea level rose by an average of 3.1mm in the recent past[2] – in the future, we expect further rises at a rate that may change even more quickly. Warmer water expands, further increasing sea levels. The effects of rising seas are already evident, with coastal lands lost or flooded, widespread erosion and saltwater intrusion. In the Western Pacific, levels have risen three times faster than the global average – the consequences for people living there are very real.

OCEAN CIRCULATION, WIND, STORMS AND WAVES

Ocean currents affect climate, and climate affects ocean currents. The wind systems that drive our ocean currents seem to be changing and intensifying, but they're doing so at different rates around the world. Some currents are warming swiftly, and changes are being felt in both hemispheres. It appears that the enhanced warming is reducing the ability of the ocean to absorb CO_2, and also contributing to more frequent and severe storms.

SALINITY

Ocean currents are also affected by salinity: saline water is denser and sinks underneath warmer, less saline surface layers. As surface layers continue to warm and become less saline, lower levels become more so. This poses an adaptation challenge for marine life depending on levels of salinity to thrive.

OXYGEN

Warmer water holds less oxygen. Models predict a decline in oxygen content of the global ocean of 1-7% by the year 2100. Warmer water also holds less nutrients, marine organisms and habitats. We can also expect to see expanding oxygen-free 'death zones' where no marine life is supported, along with more hypoxic regions (low oxygen).

OCEAN ACIDIFICATION

The ocean plays a vital role in climate modulation: it stores 50 times more CO_2 than the atmosphere and absorbs up to 30% of the annual emissions of anthropogenic CO_2,[3] helping to alleviate the impacts of climate change on the planet. But as global carbon emissions continue, ocean chemistry is changing: the more CO_2 the ocean absorbs, the more acidic it's becoming.

By the end of the century models project that ocean acidity will be increasing at a rate 10 times faster than any other ocean acidification events in the last 55 million years. This is very bad news for the many marine organisms – such as coral, clams, plankton and others – which rely on stable chemical conditions to build their calcium-based shells and other structures. While exact predictions are impossible to make, evidence from the past shows that much slower acidification events caused mass extinctions: today's unprecedented rate of acidification could lead to immense change.

As with other climate change effects, ocean acidification is taking place at different rates around the world. It's more pronounced in coastal areas – where millions of fishers across the developing world subsist – than in the open ocean.

CORAL REEFS ON THE EDGE

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By the end of the century, 99% of coral reefs are likely to experience bleaching so severe as to cause coral death: we risk losing all our coral reefs.[4] This would be a tragedy. Overall, coral reefs are the home of 25% of all marine life, and more than a quarter of the world's small-scale fishers depend on them for their livelihoods. Coral reefs are built by small animals working in partnership with algae: microalgae provide the coral with about 90% of its energy, while coral filters nutrients and acts as a host for the algae. Climate change is hitting coral reefs in two ways. First, warming water disrupts the symbiotic relationship: the algae become stressed and leave their host (the coral), which loses its colour in a process known as 'bleaching'. If the algae don't swiftly return, the coral will die and the reef will be covered by microalgae and turn to rubble. Second, increased levels of acidity interfere with corals' ability to build a skeleton and grow. At higher levels the coral skeleton may become porous, and coral larvae have deformed skeletons and low survival rates. Severe coral bleaching events are happening more frequently.

PTEROPODS
DISAPPEARANCE WOULD DIRECTLY DISRUPT FOOD CHAINS

PTEROPODS

Corals aren't the only tiny organisms threatened by increased acidification. Pteropods – so-called 'sea butterflies' – are delicate swimming molluscs that form the basis of many food webs for fish species including salmon. Pteropods have a shell which dissolves in more acidic conditions, leaving them unable to absorb nutrients. Their disappearance would directly disrupt food chains, and the impact would be felt all the way to our dinner plates.

WARMER WATERS
CHANGE THE METABOLISM OF FISH AND OTHER CREATURES

FISH IN A WARMING OCEAN

A warmer, more acidic ocean has been shown to alter the nervous systems of fish as well as fish physiology. Along with changing resource availability, evolving species distribution and new environmental cues, it's quite possible that some individuals will completely change their behaviour. Experiments have shown warmer and more acidic water disrupting fishes' ability to find food, interfering with their ability to find a home, and preventing symbiotic relationships with other creatures. This would have an impact on population dynamics and, by extension, entire ecosystems.[5]

Warmer waters also change the metabolism of fish and other creatures. Oxygen demand increases with rising temperatures – a possible consequence is smaller fish, their reduced body size increasing their relative rate of oxygen uptake. Smaller fish means lower ocean biomass, which means reduced catches for fishers.

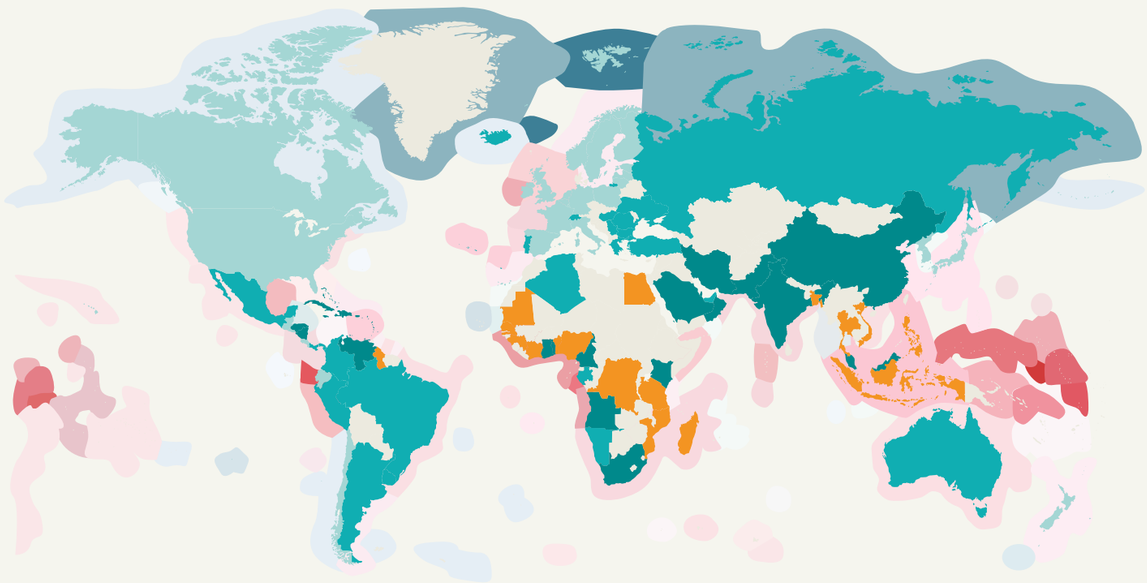
OVERALL VULNERABILITY EXPOSURE

KEY 1: of 109 countries to fisheries-related food security risks associated with climate change[6]

Very low | Low | Moderate | High | No data

KEY 2: Projected changes in maximum catch potential (%) under RCP8.5 by 2050[7]

100 75 50 25 0 -25 -50 -75 -100



FISHERIES AND CLIMATE CHANGE

Climate change is already hitting global fisheries. As described above, some marine food webs and ecosystems are likely to alter dramatically, and productivity will go down as a result. One of the key reasons is that species distribution is changing, with many fish stocks moving further out to sea into deeper water and towards the poles to track suitable temperatures. Fishers are also having to cope with changing weather patterns, storms, coastal erosion and sea level rise, making their operations less safe and less effective.

Coastal fisheries in the global south will be hit the hardest – and these countries have the least capacity to absorb the changes.

EVERY DEGREE CELSIUS OF WARMING, GLOBAL CATCH POTENTIAL WILL GO DOWN BY MORE THAN

3 MILLION TONNES

PRODUCTIVITY: GOING DOWN

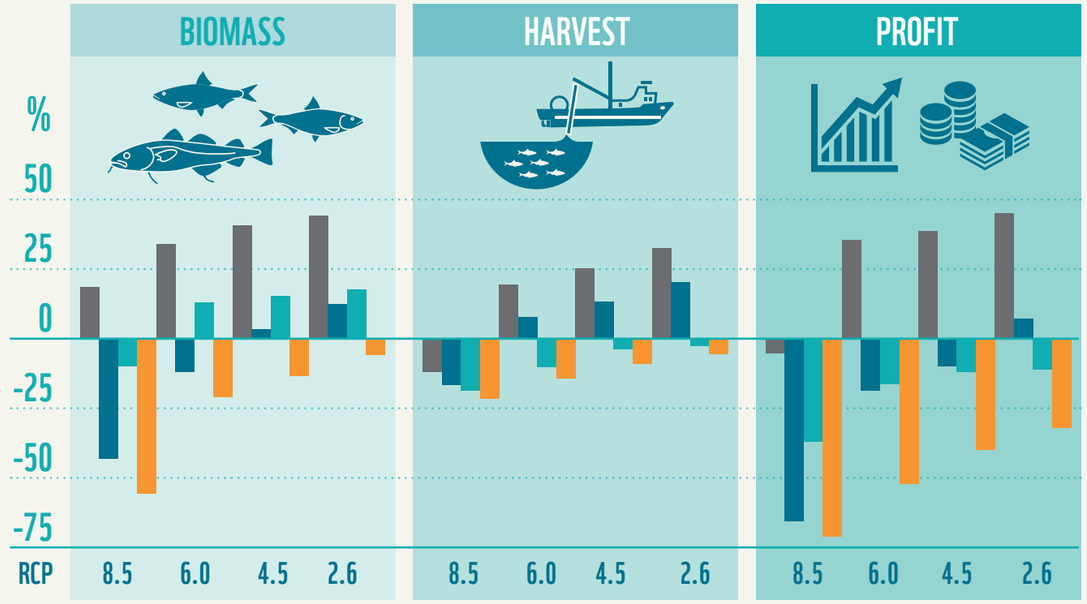
Scientists project that for every degree Celsius of warming, global catch potential will go down by more than 3 million tonnes.[8] Developing countries in lower latitudes which are warming faster than the global average (e.g. North Africa) face a reduction in annual catches of up to 50%. Many small-scale fishers will find they can no longer reach fish stocks as they move further out to sea.

Some of the most important species for food security, like anchovies and sardines, are particularly dependent on the climate. Changes along longitudes are also expected as fish track shifting food sources – tuna in the Pacific, for example, are expected to move further east.

This affects everybody. As the global population looks set to reach almost 10 billion by 2050 and we need more resources than ever before, we're unlikely to be able to rely on fish in the same way as we did in the past – neither nutritionally, economically, culturally, socially nor recreationally.

ADAPTING TO CLIMATE CHANGE CAN IMPROVE

Percent difference in biomass, harvest, and profit relative to today[13]



Representative concentration pathways (**RCPs**) map the level of greenhouse gases (**GHGs**) in the atmosphere under different emissions scenarios. The higher the number, the more concentrated the GHGs.

FOOD SECURITY

Since 1961, the annual increase in global fish consumption has been two times higher than population growth.[9] More than two-thirds of developing countries in Africa, Asia, Oceania and Latin America depend on their domestic marine fisheries as a main source of nutrition. They're also the most vulnerable to the effects of a warming ocean. Food security may be threatened as territorial waters become less productive. This has major implications for fisheries management – a challenge made more acute thanks to a drop of almost a third in official development aid for fisheries from 2010 to 2015.[10]

Developing countries lack infrastructure and investment, and they have an economic incentive to export high-value sustainable species – this, though, leaves only low-value wild and farmed fish for marketing locally, which offer fewer nutritional benefits. Malnutrition is a real possibility for poor communities in lower latitudes who used to be able to rely on their wild catches to meet their nutritional needs.[11]

AQUACULTURE ACCOUNTS FOR

50%

OF FISH EATEN GLOBALLY

AQUACULTURE – A SOLUTION?

Aquaculture is probably the world's fastest-growing food production sector, and accounts for more than 50% of fish eaten globally. Despite its continuing expansion, however, it's unlikely that it will be able to fill the gap left by diminishing wild catches in developing countries – and climate change brings challenges to this sector too.

Problems with aquaculture include its heavy use of feed made from wild-caught fish, which are impacted by the climate change issues discussed in this paper. Suitable coastal sites in many regions are facing higher sea levels and potential damage from more extreme weather. Poorer countries will always be under pressure to convert fish raised through aquaculture into hard currency by exporting to other markets rather than feeding their domestic population.

CLIMATE CHANGE IN THE OCEAN

LIVELIHOOD AND NUTRITION

Reduction of selected ecosystem services provided by ocean and human dependence on the ecosystem

SEA LEVEL RISE

25 cm

over last 140 years, since the 1990s - 3 mm per year

ELEVATED CO2

elevated sea surface temperature and ocean acidification, storms, and local stressors leads to worsened conditions for coral reefs

DECLINE IN OXYGEN CONTENT

1-7%

by 2100

AS THE OCEAN WARMS

50%

potential reduction in annual catches is faced by developing countries

PTEROPODS

Pteropods have a shell that dissolves in acidic conditions, their disappearance directly disrupts food chains

LESS SALINE LAYERS

poses an adaptation challenge for marine life

GLOBAL FISHERIES REVENUE COULD DROP BY

35%

by 2050 under high CO2 emission scenarios

CORAL BLEACHING

Corals are sensitive to ocean temperature: when their thermal threshold is exceeded they bleach, leading to reef death

WARMER WATER

causes physiological and behavioural changes in fish

25%

Coral reefs are home to a quarter of all marine life

MUSSELS AND OTHER BIVALVES

rely on stable pH levels to build calcium-based shells

SMALL ISLAND STATES AND DEVELOPING COUNTRIES RISK LOSING UP TO

70%

OF THEIR REVENUE AS THEIR CATCHES DIMINISH

ECONOMIC IMPACTS

No one stands to benefit economically from warmer seas. Projected increases in fish catches in high latitudes are for low-value species, while some small island states and developing countries in the global south risk losing up to 70% of their revenue as their catches diminish. It's estimated that global fisheries revenues could actually drop by 35% more than global catches by 2050 under high CO2 emission scenarios as high value fish decrease in number.[12]

FISHERIES MANAGEMENT

A changing climate poses a huge challenge for fisheries management, which will have to account for shifting fish stocks, changing habitats and smaller fish. Current management targets may need to be revised with these factors in mind. Developing countries in particular lack information on responses to climate change and adaptation strategies.

That said, wise management can and does make a huge difference. Sustainable stock management, a reduction in discards, increased consumption of species from lower down the food chain and a transition to sustainable aquaculture methods would all help the situation. Scientists estimate that if full adaptive management were put in place on a global scale, we could see a 60% increase in fish biomass, a 34% increase in harvest and a 154%[13] increase in profits by 2100 – but only if global warming is kept in check. A concerted and adaptive response to climate change would mean more abundant fish populations, more seafood and better profits. On the other hand, inaction on fisheries management and climate change will lead to dramatic falls in fishery productivity and negative impacts for people and the environment alike.

WWF – WORKING FOR THE WORLD'S OCEANS

WWF is working globally for resilient oceans with functioning ecosystems that support rich biodiversity, food security and sustainable livelihoods all over the world. We work with fishers, scientists, businesses, authorities – and we also need your help!

For more information please visit the Fish Forward website: www.fishforward.eu

WHAT CAN YOU DO?

Everyone can help in the fight to save our oceans. The most important thing consumers can do is to buy sustainable fish:

- Sustainably managed fish stocks will cope better with the changing environment
- Healthy stocks and sustainable fisheries governance means fishing has a reduced footprint on the ecosystem: this leads to more resilient ocean populations and habitats.
- Healthy stocks mean less fuel and other resources needed to harvest them
- Fish from responsible aquaculture don't destroy coastal habitats – such as mangroves – that are key as critical ecosystems supporting communities adapt to climate change.

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