Fact Sheet: Climate Change

Region

North Coast, Gascoyne Coast, West Coast, South Coast, Indian Ocean Territories

Summary

The Earth's climate is not static, having changed many times throughout history in response to natural causes.

When ‘climate change’ is discussed today, it is referring to changes in global temperatures over the last century and future as a result of human actions. These include the burning of fossil fuels (coal, oil and gas), agriculture and land clearing. These practices have increased the amount of greenhouse gases emitted into the atmosphere, resulting in warming of the earth’s surface, known as ‘global warming’.

Climate change is regarded as one of the most serious long-term threats to tropical marine environments, with widespread changes already occurring. Climate change is causing the world’s oceans to warm and acidify, leading to coral bleaching and reduced growth rates. Marine plants and animals are shifting towards the poles, changing marine food webs and impacting the plants and animals (including people) that depend on them. Sea levels will continue to rise along with increasing coastal erosion, and there are likely to be stronger and more frequent extreme weather events, such as heatwaves, fires, floods and tropical storms.

Rising sea levels

Global sea levels are predicted to rise by more than 60 centimetres during the next 100 years due to the melting of glaciers, polar ice and thermal expansion of warmer water. Sea level rise will not be uniform however, and some regions may experience much higher rates, dependant on local conditions such as changes in wind, air pressure and freshwater flows. Rising water levels will have serious impacts on marine ecosystems. The amount of light reaching offshore plants and algae dependent on photosynthesis may be reduced, whilst coastal habitats are already being altered.

Acidic oceans

After absorbing a large proportion of the carbon dioxide released by human activities, the oceans become more acidic. Corals are calcifying organisms, taking dissolved material from the surrounding seawater to grow their calcium carbonate skeleton. Corals are not alone in doing this – many marine plants and animals build calcareous crusts, skeletons or shells, contributing to the growth of reefs. Whilst the effects of ocean acidification on the marine biosphere are not fully documented, progressive acidification is expected to have a negative impact on plants, animals and dependent species, since the process of calcification is linked to the pH of seawater. As seawater becomes slightly more acidic, the growth (calcification) of many 'shell building' species is increasingly compromised.

Many processes, such as deposition of the marine cements that attach benthic organisms to surfaces and fertilisation of eggs by sperm, only function properly in an environment within a certain range of pH. Acidification may therefore impact the number of larvae produced by organisms that release eggs into the ocean.

Absorption of carbon dioxide by seawater will also change the composition of dissolved gases in the water. Fish, squid and other gilled marine animals may find it harder to 'breathe', as extraction of the dissolved oxygen from acidic waters becomes more difficult.

Coral bleaching

Coral bleaching is not a new phenomenon, with coral animals sensitive to a variety of stresses, and bleaching a natural response. Since the first recorded global mass coral bleaching episode in 1998, which was caused by unprecedented thermal stress, the phenomenon has been under intense scientific scrutiny. Scott Reef, an offshore Kimberley atoll, experienced bleaching during this period and lost 80 percent of its coral cover to depths of 30 metres.

The stress induced by higher temperatures causes a breakdown in the fundamental relationship that is at the heart of all coral reefs; the mutually beneficial bond between the coral animal and its symbiotic algae, zooxanthellae. The fragile equilibrium of this relationship operates within a finely tuned sea surface temperature range.

Once bleaching begins, it tends to persist even without continuing stress. If the coral colony survives the stressful period, zooxanthellae often require weeks or months to return to normal density. New residents may be a different species and change the composition of marine ecosystems dramatically. Often biological diversity is reduced, making the reef even less resilient to future environmental change. However, some species of zooxanthellae and corals are more resistant to stress than others.

Altered lifestyles and locations

Rising temperatures can directly affect the metabolism, life cycle and behaviour of marine species. For many species, temperature is a cue for reproduction, meaning changes in temperature can impact successful breeding. Temperature also determines the number of male and female offspring born to marine turtles, as well as some fish and copepods (tiny shrimp-like animals). Changing climate could therefore skew sex ratios and threaten their population survival.

As the oceans warm, the location of ideal water temperatures may shift for many species, which can impact human wellbeing. For example, a gradual shift in fish distribution may impact fishers in a region, whilst opening up opportunities elsewhere. The movement of Spanish mackerel southwards from northern waters due to increases in water temperature, is one potential example of distributional change. If fish productivity becomes more variable under climate change, then reliability in catches will be affected from year to year.

Other species may lose their localities for other reasons. Barramundi recruitment has been shown to be positively correlated with high river flow patterns, so reduced rainfall, as predicted in some regions, may mean fewer barramundi available to jump on an angler's hook.

Stormy weather
Most scientists consider that global warming will herald a new era of extreme and unpredictable weather. Tropical storms and heavier rainfall may increase, causing physical damage to coral reefs, coastal ecosystems and communities.

Adaptation in the Kimberley
Evidence is emerging that marine organisms may be responding faster to climate change than land-based plants and animals.

Tropical regions such as the Kimberley are characterised by warm temperatures that do not vary much throughout the year. Consequently, even small changes in temperature can potentially have more serious impacts than in places accustomed to a greater range in temperature.

Physiological acclimatisation, and or genetic adaptation, is needed for marine flora and fauna to cope with higher temperatures and more acidic oceans. If the current rate of climate change continues, plants and animals will have to acclimatise or adapt within the next few decades, rather than over the millennia.

Coral reefs in the Kimberley region are particularly fascinating. At low tide they are exposed, often up to four metres out of the water. These corals appear to be exceptionally hardy and tolerant of extreme conditions – including high sea surface temperatures, daily ambient temperatures and light exposures. It is apparent that some Kimberley corals have evolved with special biological adaptations. One hypothesis is that some species have a fluorescent protein with a photo protective role, reflecting light better and helping exposed parts of the colony. Corals also have a natural sunscreen in their mucus. Together these features appear to have enabled a specialised adaptation for survival under the extreme conditions of the Kimberley region.

Whether other marine flora and fauna can adapt quickly enough to cope with climate change, is unknown and as expected, the subject of ongoing research. The critical question, is whether the current generation of temperature tolerant species, can pass their genetic adaptations on to assist species survival in a short time span? With conditions changing rapidly, their capacity to do this within only a few generations may be crucial.