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Potential impacts

2020
- Bleaching and damage to the Great Barrier Reef equivalent to that in 1998 and 2002 in up to 50% of years
- 60% of the Great Barrier Reef regularly bleached
- Habitat lost for marine invertebrates currently confined to cool waters (>10% of Victoria's total)
- 63% decrease in Golden Bowerbird habitat in northern Australia
- 50% decrease in montane tropical rainforest area in northern Australia

2030
- Up to 58-81% of the Great Barrier Reef bleached every year. Hard coral reef communities widely replaced by algal communities
- 88% of Australian butterfly species' core habitat decreases
- 97% of Wet Tropics endemic vertebrates have reduced core habitat

2050
- 97% of the Great Barrier Reef bleached every year
- 92% of butterfly species' core habitat decreases
- 98% decrease in Bowerbird habitat in northern Australia
- 80% loss of freshwater wetlands in Kakadu for a 30 cm sea level rise

2080
- Catastrophic mortality of coral species annually
- 95% decrease in distribution of Great Barrier Reef species
- 65% loss of Great Barrier Reef species in the Cairns region
- 46% of Wet Tropics endemic vertebrates lose core habitat
- Reduced calcification for 70% of the area where deep sea corals occur
- Loss of endemic species

Changes already observed in species and natural systems in Australia linked to changing climate

Rainforest/woodland: Expansion of rainforest at expense of eucalypt forest and grasslands in Northern Territory, Queensland and New South Wales, linked to changes in rainfall and fire regimes

Sub-alpine vegetation: Encroachment by snow gums into sub-alpine grasslands at higher elevations

Freshwater swamps and floodplains: Saltwater intrusion into freshwater swamps since 1950s in Northern Territory has accelerated since the 1980s and is possibly associated with sea level and precipitation changes

Coral reefs: Eight mass bleaching events on the Great Barrier Reef have occurred since 1979, triggered by unusually high sea surface temperatures, with no serious events known prior to 1979. Most widespread events occurred in 1998 and 2002, affecting up to 50% of reefs within the Great Barrier Reef Marine Park Authority.

Birds: Earlier arrival of migratory birds; range shifts and expansions for several species; high sea surface temperatures associated with reduced reproduction in Wedge-tailed Shearwaters

Mammals: Increased penetration of feral mammals into alpine and high sub-alpine areas and prolonged winter presence of kangaroos and wallabies.

The material contained in this factsheet has been taken from research outcomes identified in Chapter 11 of "Climate Change 2007: Impacts, adaptation and vulnerability", the second volume of the Intergovernmental Panel on Climate Change's Fourth Assessment Report. The full chapter will be available from www.ipcc.ch.

Insects: Change in genetic constitution of the fruit fly Drosophila, equivalent to a 4 degree latitude shift (~400 km)

Climate change and the Great Barrier Reef

The two greatest threats from climate change to the Great Barrier Reef are:

- rising sea temperatures, which is almost certain to increase the frequency and intensity of mass coral bleaching events, and
- ocean acidification, which is likely to reduce the calcifying ability of key organisms such as corals.

Other factors such as droughts and more intense storms are likely to influence reefs through physical damage and extended flood plumes.

Temperatures only 1-2°C above the long-term summer maxima already cause mass coral bleaching which is the loss of symbiotic algae. Corals may recover but die under high or prolonged temperatures (2-3°C above long-term maxima for at least 4 weeks). The Great Barrier Reef has experienced eight mass bleaching events since 1979 (1980, 1982, 1987, 1992, 1994, 1998, 2002 and 2006). There are no records of events prior to 1979.

The most widespread and intense events occurred in the summers of 1998 and 2002, with ~42% and ~ 54% of reefs affected respectively. While impacts of coral disease on the Great Barrier Reef are currently minor, experiences in other parts of the world suggest that disease has the potential to be a threat to Great Barrier Reef reefs. Effects from thermal stress are likely to be exacerbated under future scenarios by the gradual acidification of the world's oceans which have absorbed about 30% excess CO2 released to the atmosphere. Reduced growth due to acidic conditions is very likely to hinder reef recovery after bleaching events and will reduce resilience of reefs to other stressors (e.g. sediment, eutrophication).

Even under a moderate warming scenario (2°C by 2100), corals on the Great Barrier Reef are very likely to be exposed to regular summer temperatures that exceed the thermal thresholds observed over the past 20 years.

Annual bleaching is projected under the worst-case emissions scenario by 2030, and under a mid-case emissions scenario by 2050. Given that the recovery time from a severe bleaching-induced mortality event is at least 10 years (and may exceed 50 years for full recovery), these models suggest that reefs are likely to be dominated by non-coral organisms such as seaweed by 2050.

Substantial impacts on biodiversity, fishing and tourism are likely. Maintenance of hard coral cover on the Great Barrier Reef will require corals to increase their upper thermal tolerance limits at the same pace as the change in sea temperatures driven by climate change. There is currently little evidence that corals have the capacity for such rapid genetic change and most evidence is to the contrary.

Recovery from mortality can be potentially enhanced by reducing local stresses (water quality, fishing pressure). Management initiatives such as the Reef Water Quality Protection Plan, the Representative Areas Program (which expanded totally protected areas on the Great Barrier Reef from 4.6% to over 33%) represent planned adaptation options to enhance the ability of coral reefs to endure the rising pressure from rapid climate change.