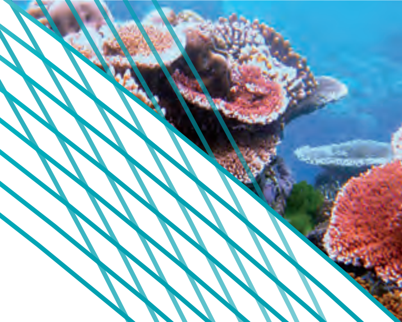


NCCARF
National
Climate Change Adaptation
Research Facility

Climate change impacts factsheet:

1. Marine biodiversity and resources

Australia's marine biodiversity and resources are significant ecologically, economically and socially. Australia's exclusive economic zone (EEZ) extends 200 nautical miles from our coastline and makes up around 2.2% of the world's ocean area. The most obvious impacts of climate change on our oceans are physical and chemical: rising sea level, ocean warming, changes in currents and increased CO_2 uptake in the ocean. These changes will in turn trigger biological responses in marine organisms. These impacts have far-reaching implications not only for how marine ecosystems function, but also for social and cultural issues, economic or market drivers, and marine management, policy and governance.

Climate and marine biodiversity and resources

The El Niño–Southern Oscillation (ENSO) is a major cause of the fluctuations in Australia's climate. ENSO is a major sea temperature and air pressure shift between the Asian and east Pacific regions. During El Niño years, temperatures are warmer than average in the east Pacific and cooler than average over the Indonesian region. During La Niña years these effects are reversed. ENSO affects Australia's marine EEZ to differing degrees around the coast. The sensitivity and vulnerability of Australia's marine biodiversity and resources to ENSO is complex and regionally variable:

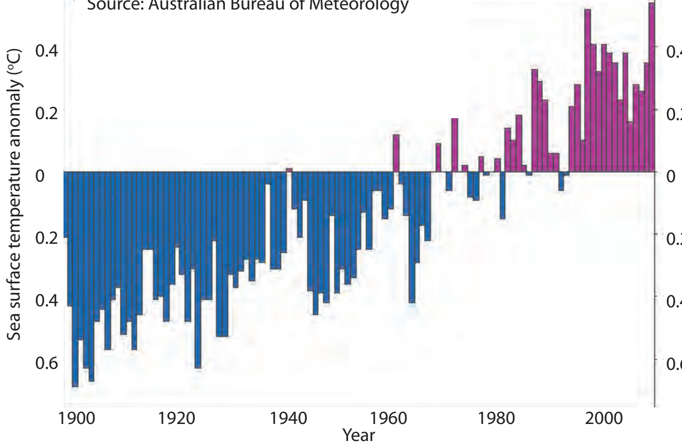
- during La Niña years there is improved settlement of western rock lobster larvae around Western Australia;
- during El Niño events there are improved scallop harvests in Shark Bay;
- ocean warming along Queensland's Great Barrier Reef in January-March of the year immediately following an El Niño event makes the reef vulnerable to coral bleaching.

Intense tropical cyclones and extreme rainfall or drought events associated with La Niña/El Niño can be beneficial or detrimental depending on the region and/or marine species.

Future climate trends

Rates of warming in south-east and west Australian waters are already substantially higher than the global average warming rate (Figure 1). Sea surface temperatures in south-east Australian waters are projected to be at least 2.5ºC warmer by 2100. The East Australian Current is expected to continue to increase in strength, bringing more persistent warm, salty and low nutrient waters off Tasmania's east coast. Increasing atmospheric CO_2 concentrations are associated with increased CO_2 uptake by the oceans and ocean acidification. Between 1751 and 1994, the acidity of the world's oceans has increased by close to 30%.

Figure 1. Annual sea-surface temperature anomaly - Australian Region



Climate change impacts and vulnerabilities

Australia's marine environment is at risk from changes to ocean temperature, salinity, sea level, mixed layer depth, circulation, pH, and from changes in atmospheric radiation and climatic extreme events. The differing physiological tolerances, resilience and adaptive ability of marine species will lead to changes in their distribution, abundance, and community structure. Examples include:

- Warming of turtle nesting beaches may produce an imbalance in the offspring male:female ratio, reducing future breeding performance.
- Coral bleaching occurs as a result of most coral species' inability to tolerate unusually high water temperatures; bleaching events are likely to become more common as oceans warm.
- Warmer waters will allow increased occurrence of tropical fish in southern seas.
- Nutrient-poor waters brought south by the East Australian Current may affect productivity in the edible oyster industry.
- Continued declines in recruitment and biomass in southern rock lobster are expected, with regional changes in the associated fisheries.
- Disease may increase as symbiotic associations break down, while both pests and disease could be exacerbated by an increase in sea water temperature.
- The range of toxic algal blooms can be expected to expand; e.g. the red-tide dinoflagellate, *Noctiluca scintillans*, has expanded its range from Sydney into southern Tasmanian waters, causing problems for the salmon farm industry.
- Ocean acidification is expected to affect the physiology and metabolism of marine organisms with carbonate body parts, such as corals and shellfish.

Social and economic impacts

It is likely there will be both winners and losers as a result of changing conditions. With shifts in the distribution of species, populations of established fishing grounds may be reduced or replaced by other species, affecting the profitability of fishing. The fishing industry may be faced with longer and more costly journeys to fishing grounds and higher workloads associated with new policies, legislation and regulations related to the management and conservation of marine resources. For the aquaculture industry, increased outbreaks of disease, nutrient pulses, algal blooms and storm surges can affect profitability.

Marine and coastal ecosystems provide high lifestyle and tourism values which could be negatively affected by the impacts of climate change. For example, although a 'last chance to see' phenomenon may boost tourism in the short to medium term, coral bleaching and degradation of reefs would ultimately cause the decline of much marine tourism with follow-on socio-economic effects for coastal communities. Rising sea-level also has serious implications for developments close to the shoreline, which may have difficulty obtaining property insurance against flood and wind damage, may lose value, and may ultimately be forced to relocate. Local council planning regulations are beginning to take these risks into account.

Adaptation: practices, options and barriers

Fishers have traditionally been obliged to adapt to seasonal differences and climatic events and to withstand the economic consequences. Climate change, however, presents a new dimension.

The adaptive capacity of fishing businesses can be built by responsive business practices and improved fishing technology, informed by the best available scientific information on climate and the marine environment. The survival potential of those species susceptible to climate change will be enhanced by strategic programs to restore and protect fish habitats and breeding grounds in temperate and coral reefs, seagrass beds, mangroves and salt marshes as well as fish refugia.

Flexible policies that support, for example, ecosystem-based fisheries management and/or strongly consider conservation and ecological issues while enabling innovation and adaptation will be critical. Citizen science programs such as Redmap, and ready access to shared research datasets, such as those available through the Australian Ocean Data Network, will assist in improving research information.

Research priorities

Key research priorities identified by researchers, stakeholders from government and peak bodies and industry include:

- selective breeding to produce more resilient, disease resistant aquaculture species with increased physiological tolerance to temperature and pH changes;
- studies of the interface between marine and terrestrial environments, flood plains, mangrove flats, wetlands and coastal areas; and,
- identification of indicator species to predict range shifts.

Research will need to be interdisciplinary and trans-disciplinary with strong engagement between researchers and industry. Collaboration to establish baseline data in a national integrated program of climate change monitoring and modelling should help reduce duplication, improve projections and benefit management and policymakers in all sectors.

Beneficial opportunities may also arise, for example, the aquaculture industry might be able to explore carbon dioxide sequestration. Better engagement and common-language communication between researchers and marine stakeholders about vulnerabilities and adaptation options will enable adaptive capacity building. Actions that reduce non-climate stressors (e.g. chemical runoff) on the marine environment will most likely reduce the impacts of climate change on marine species.

About the Network

The Marine Adaptation Network encourages cooperation, discussion and collaboration between marine sectors to address common concerns about climate change impacts, and to develop adaptive response strategies. The Network promotes collaborative, interdisciplinary research and Network theme leaders have prepared a suite of integrated synthesis papers of sectoral climate change impacts and adaptation case studies for publication. Graduate schools have been held to educate the next generation of marine adaptation researchers, and Network scholarships support students researching aspects of marine adaptation which will inform policies and management decisions. The Network website, information sheets and the quarterly Marine Adaptation Network Bulletin present information about contemporary and emerging knowledge and activities. For more information see www.arnmbr.org

Image: Harry Kontos

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