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National  
Climate Change Adaptation  
Research Facility

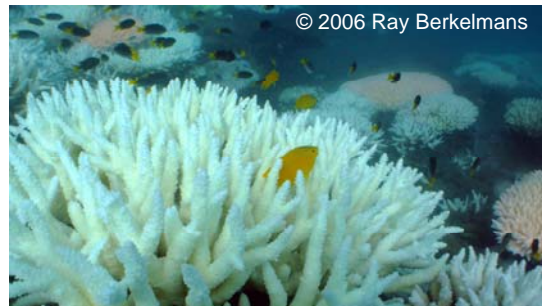
Adaptation Research Network  
MARINE BIODIVERSITY AND RESOURCES

## Species response to climate change in the ocean

Climate change is modifying the temperature and chemistry of our oceans, with direct and indirect consequences on the oceanography and functioning of marine ecosystems. Below are some of the expected and/or observed responses of marine species to climate change.

### Physiological responses

All marine organisms live within a limited range of temperature and pH corresponding to the range where cellular exchanges and whole-organism processes are optimised for the species. Acidification and/or increases in ocean temperature can push some species towards their physiological limits (i.e. the edges of their thermal or pH range), resulting in negative effects on the organisms' growth, reproduction, foraging, immunity, behaviour and competitiveness<sup>1</sup>. A well known example is the bleaching of tropical coral reefs caused by the dissociation of corals and their symbiotic unicellular algae at temperatures close to their upper thermal tolerance. Laboratory studies have also demonstrated negative physiological responses in other species under predicted climate change conditions, including compromised fertilisation and early development in the purple sea urchin<sup>2</sup> and impaired oxygen transport in squids<sup>3</sup>.



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can be characterised by specific water temperature and salinity, depth range, substrate, as well as the presence of adequate food supplies and shelter.

Environmental changes associated with climate change are leading species to move to different locations to match their habitat requirements. For example, many



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### Changes in distribution

Marine species have a particular habitat preference which reflects the most suitable environment for them to thrive and defines their distribution. Suitable habitats



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benthic and demersal fish species in eastern and south-eastern Australia are shifting polewards to cooler waters<sup>4</sup>. In some cases this is creating significant negative impacts by promoting the spread of invasive species (e.g. the long spined sea urchin establishment in Tasmania<sup>5</sup>).

## Changes in phenology

Phenology corresponds to the timing of life-history events (e.g. timing of egg-laying, migrations, peaks in abundance). Changes in phenology are important because species' life cycles are



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interconnected and changes in the life-history of one species can affect many others, potentially resulting in an asynchrony between dependent species (i.e. decoupling of phenological relationships).

Phenological changes are not easily observable in marine systems and long term datasets are lacking in Australia. Nevertheless, changes in phenology have been detected in seabirds<sup>4</sup> (i.e. earlier laying) and are expected to affect other taxa (e.g. plankton, as observed in the North Sea where substantial temporal modifications in seasonal succession peaks have been observed in the last few decades<sup>6</sup>).



## Changes in abundance

Through impacts on oceanography, ocean productivity, species' physiology and phenology, climate change is responsible for changes in species' abundance throughout the oceans. Examples in Australia include regional changes in phytoplankton abundance (i.e. increase in blooms) and decline in macroalgae along the east coast of Tasmania<sup>4</sup>, with many more changes expected in the years to come.

## References

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Fact sheet prepared by:  
Jessica André and  
Gretta Pecl

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**Adaptation Research  
Network for Marine  
Biodiversity &  
Resources**

## Contact Address

School of Geography  
and Environmental  
Studies  
University of Tasmania  
Private Bag 76  
Hobart, TAS 7001  
Australia

Phone: 03 6226 2134

Fax: 03 6226 7628

[arnmbr@arnmbr.org](mailto:arnmbr@arnmbr.org)

## About the Marine Adaptation Network

The Adaptation Research Network for Marine Biodiversity and Resources is hosted by the University of Tasmania and convened by A/Prof Neil Holbrook. The Marine Adaptation Network is supported by 14 partners nation-wide. This interdisciplinary network aims to build adaptive capacity and adaptive response strategies for the effective management of marine biodiversity and natural marine resources under climate change. For more information on the Marine Adaptation Network, or to subscribe to become a member of the Network, please email [arnmbr@arnmbr.org](mailto:arnmbr@arnmbr.org).



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