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National
Climate Change Adaptation
Research Facility

Adaptation Research Network
MARINE BIODIVERSITY AND RESOURCES

Ecosystem responses to climate change in the ocean

Climate change is modifying the temperature and chemistry of the oceans, with direct consequences on oceanography, species, and the functioning of marine ecosystems. The responses of marine ecosystems to climate change fall into several categories, including changes in productivity, changes in community structure, and changes in ecosystem function (processes that contribute to ecosystem maintenance) and ecosystem services (resources and processes that are supplied by natural ecosystems and support human quality of life). It is important to note that the resilience of our marine ecosystems to the potential impacts of climate change is also affected by interactions with other human threats such as pollution and overfishing.

Changes in productivity

How a changing climate will modify ocean systems is difficult to predict, but most evidence suggests that the net effect will be negative. Climate change induced modifications of ocean circulation, pH, seawater chemistry, nutrient availability from coastal runoff, incident solar radiation, upwelling and surface winds will change ocean primary production (e.g. phytoplankton biomass). These changes in primary productivity are expected to propagate upwards in marine food chains, leading to increased productivity in some systems and decreased productivity in others. So far, such changes have not yet been detected in Australian waters, although it is important to note the lack of long-term marine data sets in the region. While future changes in deep-sea and land-based nutrient supply to the surface ocean are speculative, it is expected that Australia's already low productivity will decrease further in areas where nutrient supply to surface waters declines¹.



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Changes in community structure

The assemblages of species in ecological communities reflect interactions among organisms as well as between organisms and their environment². Ocean properties responding to climate change will alter the dynamics between species, favouring increased predation and grazing in some areas, facilitating invasion in others and reducing biodiversity. Modifications to

species ranges (either through range extension or range shift), tends to initially increase the local biodiversity (i.e. species richness) as new species arrive in a region. This has already been observed in Tasmanian waters where New South Wales fish species have become established south of Bass Strait and others have shifted their range south along the Tasmanian coast¹. Changes in community structure can also result from the disappearance of

local species due to unfavourable conditions – an example being lower coral biodiversity recorded on the Great Barrier Reef as a result of changing rainfall regime and runoff associated with climate change³.

Changes in ecosystem function and services

Marine biodiversity provides most ecosystem services we obtain from the sea, including food, protection against coastal erosion, recycling of pollutants,



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climate regulation, and recreation⁴. Biodiversity loss as a consequence of climate change can result in disruption to marine ecosystem function and loss of ecosystem services. While there are limited published data available for Australia, analyses of results from local experiments and long-time regional time series worldwide show that declining biodiversity (through loss of marine species or entire functional groups) increases the rate of resource collapse and decreases the recovery

potential, stability and water quality of marine ecosystems⁵.

See also: Fact Sheet 1: Species responses to climate change

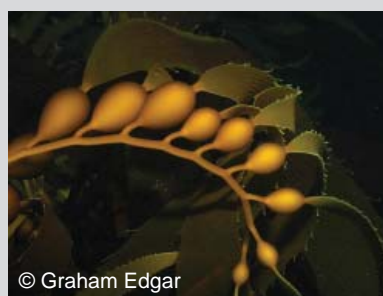


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About the Marine Adaptation Network

The Adaptation Research Network for Marine Biodiversity and Resources (or simply, the Marine Adaptation Network) is hosted by the University of Tasmania and convened by Assoc Prof Neil Holbrook. The Network is supported by 14 partner institutions nation-wide. It comprises a holistic framework of interconnecting marine themes that cross-cuts climate change risk, marine biodiversity and resources, socio-economics and policy. 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 visit <www.nccarf.edu.au/marine/>



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