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National
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Adaptation Research Network
MARINE BIODIVERSITY AND RESOURCES

Climate change impacts on Tasmania's marine life

Climate change is altering the temperature and chemistry of the world's oceans, which is in turn affecting our marine habitats and species. The waters around Tasmania are warming at a rate much faster than the global average. The east coast of Tasmania fringes upon an ocean warming 'hotspot' due to the extension and strengthening of the East Australian Current which carries warm tropical waters south along the east coast of Australia. Below are some of the expected and observed responses of marine species to climate change in Tasmania.

Physiological responses

Marine organisms have a preferred range of environmental conditions for which their physiology is adapted. Changes to temperature and pH (among other parameters) can alter vital physiological processes such as growth and reproduction. For example, a controlled laboratory study has demonstrated that early stage lobster phyllosoma larvae have faster growth and feeding rates at 18°C than at 14°C¹, and historical field data suggest that rock lobster growth in the south of Tasmania has increased due to warming waters². Likewise, historical growth rates derived from otoliths (ear bones) in banded morwong have also been correlated to increasing water temperature³. There is also some evidence to suggest that warming temperatures may negatively affect the growth of black-lipped abalone. The patterns of maximum size closely follow mean water temperatures around the Tasmanian coast, with larger individuals occurring in cooler southern waters⁴.



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Changes in distribution

Climate change can strongly influence the distribution and abundance of marine species through changes in growth, survival, reproduction, or responses to changes at other trophic levels. This is particularly relevant for Tasmania as species move poleward in response to warmer

waters to maintain the thermal environment to which they are adapted. A well documented case is the southern range expansion of the invasive sea urchin *Centrostephanus rodgersii*, a native to New South Wales (NSW), along the east coast of Tasmania⁵. Similarly, there has also been recent range expansion of the red-tide dinoflagellate *Noctiluca scintillans*, also from NSW to Tasmania⁶. The distribution of at least several dozen fish species has changed substantially over the last few decades (Last P *et al*, unpub data), and are thought to be related to temperature increases. Many of these species have undergone range expansions from the waters surrounding mainland Australia.



Noctiluca scintillans © Anita Slotwinski

Changes in phenology

Phenology is defined as the timing of life-history events, such as spawning, migrations and peaks in abundance. Phenological changes are difficult to detect in marine species and little information exists in Australia, although there is some evidence of phenological changes in some Tasmanian species. The egg laying dates of little penguins in Bass Strait, for example, are earlier in warmer years⁷ [and references therein], and there has been a shift in the timing of peak rock lobster puerulus settlement observed over the last decade (from July to October)². Predicted changes in the timing or duration of life cycle events include an increase in the length of the defined seasonal temperature window for blooms of the toxic dinoflagellate, *Gymnodinium catenatum* (Hallegraeff G, unpub data).

Changes in abundance

Changes in physiology, distribution and phenology can modify a species' abundance. Tasmania has seen changes in phytoplankton abundance, such as an increase in *Noctiluca* blooms⁶, and a decline in giant kelp⁸. Lobster recruitment has declined gradually over the last 15 years off eastern Tasmania, with predictions of biomass decline likely to occur first in northern and north-eastern regions and eventually in the south. Recent increases in the abundance of one species in particular has been a cause for concern - the invasive sea urchin *C. rodgersii*, a voracious grazer of kelp, has resulted in a decline in kelp forest and an increase in urchin 'barrens'. The increase in distribution (see previous section) and abundance of this species is expected to continue to negatively impact on reef species.

Experiments have shown, for example, that increased densities of *C. rodgersii*, as the superior grazing competitor, causes an increase in abalone mortality rates⁹.

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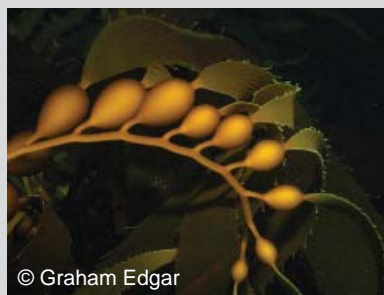
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Aerial photograph of red *Noctiluca* dinoflagellate slicks in Parsons Bay, Tasman Peninsula, in March 2002. (photograph: Judi Marshall & Gustaaf Hallegraef, School of Plant Science, University of Tasmania).

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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