ECOS SCIENCE FOR SUSTAINABILITY

www.ecosmagazine.com

Published: 16 July 2012

Australia's tropical sea-life heading south

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Researchers warn that ocean warming will result in 'tropicalisation' of marine biological communities off the Western Australian coast.

Credit: Timitrius/flickr

Mainland Western Australia's 13,000 km-long coastline has a tropical climate in the north, where it borders the Indian Ocean, and a temperate one in the south, where it borders the Southern Ocean. This continuum of tropical to temperate environments harbours a high diversity of marine organisms.

Western Australian coral reefs are ranked second in the world in terms of the number of endemic species. Within the state's temperate reefs, up to 80 per cent of fish species are unique to Australia. These rich biological resources support a range of commercial and recreational fisheries that target species such as the Western rock lobster, sharks and dhufish.

Environmental changes, particularly atmospheric warming driven by greenhouse gas emissions from human activities, are affecting ocean life globally. In Australia, the average sea-surface temperature has increased by more than 0.7ºC since 1910. The central west coast of Australia is warming at an even faster rate, making it an Indian Ocean hotspot. If the current rate of greenhouse gas emissions continues, sea-surface temperature in Western Australia waters is expected to increase by a further 1.5–3ºC by 2100.

Marine fish and invertebrates are highly sensitive to rapid environmental change. They perform optimally within a certain range of temperatures and conditions; their growth can be reduced when temperatures or conditions are above or below that range. Changed environmental conditions may also cause species to move and colonize into new habitats.

These changes can have significant implications for biodiversity conservation and fisheries.

To assess the extent of the impacts of climate change on marine biota in Western Australia, we applied a suite of computer models, based on a particular future greenhouse gas scenario used in reports by the IPCC (Intergovernmental Panel on Climate Change).

These included:

1. a model developed at CSIRO by Dr Ming Feng and colleagues that downscales regional oceanographic models of climate change impacts to fit the oceanographic features (ocean boundary currents, temperature, etc.) of Australian waters.
2. a biological model developed by Dr William Cheung and colleagues at the University of British Columbia that predicts distribution of marine fishes and invertebrates.

We then selected 30 species of fish and shellfish that are representative of Western Australia's marine biological community. Using distribution data produced by Dr Jessica Meeuwig and colleagues at the University of Western Australia and the WA Department of Fisheries, we applied our models to project future distributions of these organisms under different emission scenarios.

Credit: Nemo's great uncle/flickr

The results suggest that under a 'business as usual' emissions scenario, most of the studied organisms will shift their distribution southward and into deeper waters, a finding that is consistent with those from large-scale projections and observations made elsewhere.

Over the next 50 years, the shift is likely to be between tens and hundreds of kilometres further south, and tens of metres deeper than present distributions. This means that if you now live in temperate parts of the Western Australian coast, you can expect to see or catch more warm tropical water species in the decades to come. Our models suggest that this tropicalisation or southward shift of marine species will apply all around Australia.

Such changes have already been observed. For example, following a recent increase in sea-water temperature off

Western Australia, fish species normally restricted to the north coast have been found further south. Thus tropical damselfishes, such as the Indo-Pacific sergeant, have become more abundant in southern Western Australia. The western rock lobster‘s distribution too has shifted to deeper waters as continental shelf water has warmed.

Credit: scienceimage

Off Australia’s east coast, the long-spined sea urchin has recently extended its distribution into Tasmania from the north and posed threats to reefs through over-grazing. This changed distribution is most likely related to enhanced East Australian Current flows during the past decades.

The tropicalisation of marine communities has ecological and socio-economic implications. For example, food may become less abundant for long-established species as their prey is consumed by new predators. Commercial and recreational fishers may need to fish in waters outside traditional fishing grounds or to adjust to catching new species.

Indeed, current fisheries management and marine conservation measures based on existing distributions of marine organisms are likely to become less effective, making future monitoring efforts all the more important.

More information

Cheung WL, J Meeuwig, M Feng *et al* (2012) Climate-change induced tropicalisation of marine communities in Western Australia, *Marine and Freshwater Research*.

From **ECOS** online http://www.ecosmagazine.com/?paper=EC12351