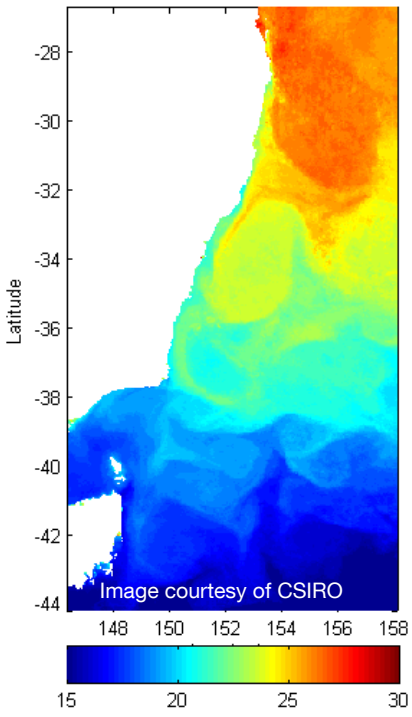
NCCARF
National Climate Change Adaptation Research Facility
Adaptation Research Network
MARINE BIODIVERSITY AND RESOURCES

Institute for Marine & Antarctic Studies
University of Tasmania
Private Bag 129, Hobart TAS 7001, Australia
Phone: +61 (0)3 6226 2134
arnmbr@arnmbr.org
www.nccarf.edu.au/marine/

information sheet 5
This information sheet was prepared as a contribution from New South Wales
Edited by Neil Holbrook. Published in April 2011.

Changes in community composition and distribution under climate change: New South Wales



The continental shelf waters of New South Wales NSW range from cool-temperate to subtropical and is often dominated by the East Australian Current (EAC) and its associated eddies, particularly in the north of the State when intrusions occur during summer and autumn[1]. The EAC provides an important physical link between tropical and temperate waters and is responsible for transporting tropical larvae to NSW coastal waters[2], generally via the main flow of the EAC in the north and eddies in the south of the State. This is particularly evident along the NSW north coast where a strong transition between tropical and temperate waters results in considerable latitudinal changes in biotic composition and distribution. There are also strong longitudinal changes in shallow water biotic composition across-shelf within the north coast region due to the presence of shallow reefs associated with islands up to 12 km off the coast[3]. These are more-strongly influenced by the EAC than inshore reefs, resulting in increased tropical representation.

There is evidence that climate change will result in strengthening of the EAC along the NSW coast[4,5], which is likely to result in higher overall temperatures and more frequent and persistent flooding of EAC water onto the inner shelf. This increased EAC influence may affect biodiversity within the Solitary Islands region by reducing levels of endemism and representation of temperate biota, with corals and other tropical fauna likely to increase in abundance on coastal reefs. However, the EAC also influences inshore processes such as upwelling of cold water[6,7], so there is a possibility that a stronger EAC will also result at times in colder water inshore.

The general biotic pattern in the region is for nearshore reefs to be macroalgal-dominated (mostly *Ecklonia radiata*), mid-shelf reefs to support both macroalgae and sponge/coral assemblages (but at different depths)[8], and shallow outer reefs to be dominated by diverse coral communities[9]. Patterns for reef fish are very similar to those for corals, with both the species richness and proportion of tropical fishes increasing offshore[3,10]. This mostly reflects the temperature gradient across the shelf, although other factors will also be important influences on these patterns – e.g. water clarity and nutrient availability.

Increasing EAC intensity has specific implications for the distribution and abundance of habitat-forming species in this region particularly scleractinian corals, and *Ecklonia radiata* which is close to its northern limit of distribution. However, recent surveys have shown no evidence of lower abundance of *Ecklonia* near its northern limit, with between site differences the greatest source of variability[11]. Poleward contraction of kelp habitats is a likely outcome of increased water temperatures[12], and a reduction in kelp habitat and associated change in community composition and ecosystem function is expected within the northern NSW region, partly as a result of increased temperature. At present there are no published records of shifts in the distribution or abundance of kelp in northern NSW due directly to climate

information sheet 5
Changes in community composition and distribution under climate change: New South Wales

change, although non-climate stresses (e.g. increased grazing, reduced water quality) are likely to already have had a considerable effect on kelp abundance and will result in considerable interactions that drive local variations in climate change induced responses.

While an increase in EAC intensity may result in higher coral recruitment within the northern NSW region, coral communities exist near their upper thermal tolerance[13], and temperatures above 26.7°C in the Solitary Islands region may result in bleaching (S. Dalton pers. com.). There is also potential for an increase in the prevalence of coral disease[14]. While minor bleaching has been recorded in the Solitary Islands region[15,16], including anecdotal records associated with the 1998 worldwide scale bleaching event, a large-scale temperature-related bleaching event in this region has not been documented. However, in early 2010 a sustained period of elevated sea surface temperature >28°C resulted in extensive bleaching at Lord Howe Island[17], which is at a similar latitude to the Solitary Islands region. This highlights the risks of any future increase in the frequency of warm water periods associated with changes in the EAC in the region.

Extensive coral bleaching at a Lord Howe Island long-term monitoring site (Photo: P. Harrison)

Monitoring of sea temperature, kelp, corals and associated fish assemblages are important components of the broader program within the northern NSW region to continue to assess the long-term changes in species, assemblages and ecosystem function. These are likely to be effective climate indicators for the region and are being assessed throughout northern NSW through a range of programs being implemented through State government and University based research and monitoring programs.

References

1. Malcolm, H.A., Davies, P.L., Jordan, A., Smith, S.D.A., (2010a). Variation in sea temperature and the East Australian Current in the Solitary Islands region between 2001–2008. Deep-Sea Research II 58, 616–627.

2. Booth, D.J., Figueira, W.F., Gregson, M.A., Brown, L., Beretta, G., (2007). Occurrence of tropical fishes in temperate southeastern Australia: Role of the East Australian Current. Estuarine Coastal and Shelf Science 72, 102–114.

3. Malcolm, H.A., Jordan, A., Smith, S.D.A., (2010b). Biogeographical and cross-shelf patterns of reef fish assemblages in a transition zone. Marine Biodiversity, 40, 181-193.

4. Cai, W., Shi, G., Cowan, T., Bi, D., Ribbe, J., (2005). The response of the Southern Annular Mode, the East Australian Current and the southern mid-latitude circulation to global warming, Geophysical Research Letters 32: L2.

5. Hobday, A.J., Okey, T.A., Poloczanska, E.S., Kunz, T.J., Richardson, A.J., (2006). Impacts of climate change on marine life in Australia. Part B: Technical Report. Report to the Australian Greenhouse Office, Canberra, Australia.

6. Roughan, M., Middleton, J.H., (2002). A comparison of observed upwelling mechanisms off the east coast of Australia. Continental Shelf Research 22, 2551-2572.

7. Roughan, M., Middleton, J.H., (2004). On the East Australian Current: variability, encroachment, and upwelling. Journal of Geophysical Research 109, C07003 07001 - 07016.

8. NSW MPA, (2010). Seabed mapping in the Solitary Islands and Jervis Bay Marine Parks, 58p.

9. Harriott, V.J., Smith, S.D.A., Harrison, P.L., (1994). Patterns of coral community structure of subtropical reefs in the Solitary Islands Marine Reserve, Eastern Australia. Marine Ecology Progress Series 109, 67-76.

10. Malcolm, H.A., Smith, S.D.A., Jordan, A., (2010c). Using patterns of reef fish assemblages to refine a Habitat Classification System for marine parks in NSW, Australia. Aquatic Conservation: Marine and Freshwater Ecosystems 20, 83-92.

11. Cardno Ecology Lab, (2010). Review of shallow rocky reef assemblages in NSW. Report to the NSW Department of Environment, Climate Change and Water.

12. Wernberg, T., Russell B.D., Moore, P.J., Ling, S.D., Smale, D.A., Campbell, A., Coleman, M.A., Steinberg, P.D., Kendrick, G.A., Connell, S.D., (2011). Impacts of climate change in a global hotspot for temperate marine biodiversity and ocean warming. Journal of Experimental Marine Biology and Ecology

13. Berkelmans, R., (2002). Time-integrated thermal bleaching thresholds of reefs and their variation on the Great Barrier Reef. Marine Ecology Progress Series 229, 73-82.

14. Dalton, S.J., Smith, S.D.A., (2006). Coral disease dynamics at a subtropical location, Solitary Islands Marine Park, eastern Australia. Coral Reefs 25, 37-45.

15. Dalton, S.J., (2003). Stressors of scleractinian corals: coral bleaching and coral disease within the Solitary Islands Marine Park (South West Solitary Island), unpublished Honours Thesis, University of New England, Armidale, NSW.

16. Edgar, R.J., Malcolm, H.A., Dalton, S.J., (2003). Coral bleaching in the Solitary Islands Marine Park, NSW. Report to Coastcare Australia.

17. Harrison, P., Dalton, S., Carroll, A., (2010). Initial Summary Report on the 2010 Coral Bleaching and Reef Surveys at Lord Howe Island. Unpublished report to the NSW Marine Parks Authority.

About the Marine Adaptation Network

The Adaptation Research Network for Marine Biodiversity and Resources (aka. 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/>