What impact will global change have on Adelaide's marine ecosystem?

By Laura Falkenberg
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Since April this year birth C15 at the CYCSA has been the field site where ecologists from the University of Adelaide, including Laura Falkenberg and Joanna Taylor, have been conducting research regarding the extent to which ecosystems will be affected by global change.

Basis of the Research

Global climate change is an increasing concern, yet the extent to which ecosystems will be affected remains unclear. This issue forms the basis of research undertaken by members of the Southern Seas Ecology Laboratories from the University of Adelaide, including PhD candidate Laura Falkenberg, and Honours student Joanna Taylor. Their research, which was initially focussed on laboratory-based experiments, is now being undertaken at the CYCSA in field-based tanks.

Figure 1: Joanna Taylor (left) and Laura Falkenberg (right) by Research Tanks at berth C15

Studying the interaction of Local and Global factors

Traditionally, predictions about the effects of climate change on ecosystems have been made based on understanding developed by studying climate change in isolation. However, the response of ecosystems will not be determined solely by global-scale conditions, but also the local environment in which they manifest. For example, it is possible that marine systems already stressed by elevated nutrients resulting from human sources, such as sewage outfall, may be more susceptible to climate change than those which do not receive additional nutrient inputs. Although potential effects can be identified by combining the findings of studies that consider global- and local-scale stressors in isolation, such an approach is unable to recognise the interactions which occur between stressors. It will only be possible to identify which type of interaction exists, and the likely response of ecosystems to future conditions, when these stressors are considered in meaningful combinations.

Importance of Kelp Forests in Temperate SA Coastlines

Studies that consider the effect of both global and local stressors on key ecosystems are now being conducted, and are beginning to identify the interactions which exist. These ecosystems include the kelp forests found on temperate coastlines, such as those of South Australia.

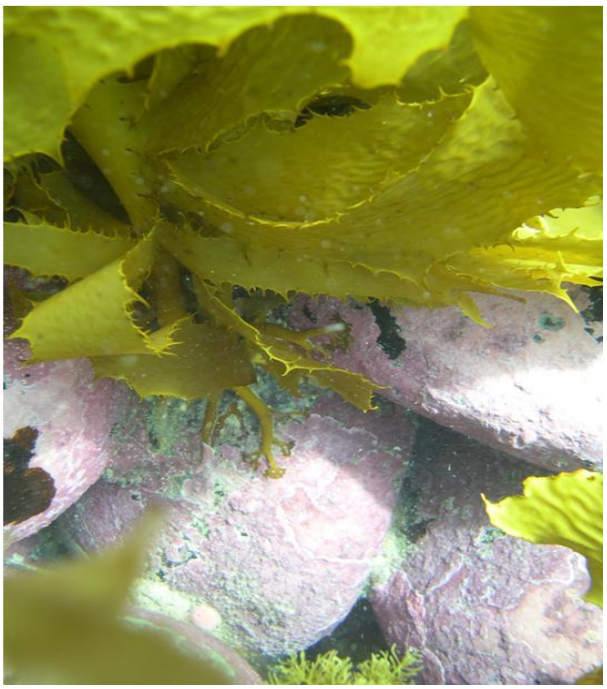

Figure 2: Kelp growing on coralline crust understorey (photo credit, Bayden Russell)

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Kelp canopies enable stabilisation of physical environments and form complex habitats for thousands of associated species. Although kelp canopies, and their coralline crust understorey, are traditionally widespread, areas of turf-forming algae also naturally occur in these ecosystems. These morphologically-simple turf-forming algae are unable to provide the same ecosystem services as kelp canopies. When empty space is created through the loss of canopy due to storm damage turf-forming algae can rapidly colonise, overgrowing coralline crusts. These filamentous turfs then trap sediment, inhibiting the recruitment of canopy-forming kelp. Under current conditions, which have been modified due to human activities, these turf-forming algae have been able to persist, preventing the re-formation of kelp forests.

Likely loss of Kelp Forests with Turf-forming algae favoured over Coralline algae

A laboratory-based study conducted at the University of Adelaide last year (which was Laura Falkenberg's Honours project[1], the results of which have been published in *Global Change Biology*) considered the response of the two key understorey species, coralline crusts and turf-forming algae, to the global-scale stressor of future carbon dioxide and the levels of elevated nutrients found on urbanised coasts.

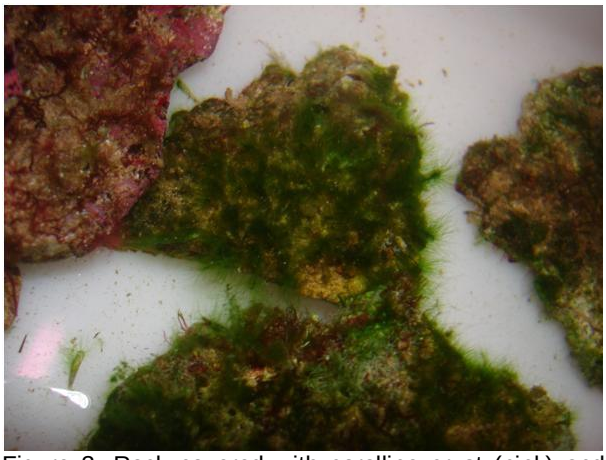

Figure 3: Rock covered with coralline crust (pink) and turf-forming algae (green)

This study found that under future carbon dioxide and elevated nutrient conditions turf-forming algae will be favoured at the expense of coralline algae, a situation that will likely lead to the loss of kelp forests.

Increasing resilience of kelp forests to global-scale climate change

Although future carbon dioxide and elevated nutrient conditions are likely to favour turf-forming algae over coralline crusts, it is possible that appropriate management of local-scale stressors could reduce the effect of global-scale change. In this algal assemblage, it may be possible to reduce the effect of elevated carbon dioxide by appropriately managing the discharge of nutrients. The first aim of the experiments being conducted at the CYCSA is, therefore, to assess the resilience of kelp forests to future carbon dioxide and elevated nutrient conditions. These community responses may be particularly important given the potential for species interactions, and therefore ecosystems, to be altered by future carbon dioxide. The second aim is to determine if the presence of kelp reduces the effect of future carbon dioxide on the understorey algae (specifically, coralline crusts and turf-forming algae). Determining this effect will be important as the presence, or absence, of kelp is known to influence the composition of algal assemblages under current conditions, and may become increasingly important under future carbon dioxide conditions. The first experiment, which addresses these aims, was started mid-August 2009 and is expected to have a duration of around 5 months. A second experiment will then be conducted to identify if managing local-scale stressors (i.e. reducing nutrient levels or re-introducing kelp canopies) can increase the resilience of kelp forests to global-scale climate change.

Ultimately, the findings of these experiments will indicate the future of the ecosystem, and be utilised in the development of management strategies aimed to conserve kelp forests. Appropriate management of local stressors, such as nutrient discharge or removal of kelp, may influence the resilience of kelp forests to climate change.

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Important Note:

- This information is provided for your interest only. It is intended to be a starting point only for your own research. It is not to be relied upon for any decisions.
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References

[1] Russell B. D. ... **Falkenberg L**, Connell S.D. (2009) Synergistic effects of climate change and local stressors: CO_2 and nutrient-driven change in subtidal rocky habitats. *Global Change Biology* doi: 10.1111/j.1365-2486.2009.01886.x