5th issue:
October
2007

Building Biodiversity

BUILDING SEAWALLS TO SUSTAIN INTERTIDAL BIODIVERSITY IN ALTERED AND URBANIZED ESTUARIES

Sydney Aquarium Conservation Foundation Grant

Contrary to public perception, water quality is not usually a major factor determining diversity in well-flushed and regulated harbours such as Port Jackson. In contrast, alterations to shorelines damage or remove intertidal habitats, usually for ever. Yet there is little public awareness of this problem. Seawalls appear to provide habitat for intertidal animals and plants, but they do not support natural assemblages. Shoreline development in urbanized estuaries has the potential to affect seriously the long-term sustainability of marine biodiversity.

Dr. Ljiljana Iveša

Diversity is estimated using simple counts of organisms, ignoring the interactions among species. Natural interactions among species, (e.g. between resources and consumers, competitors, parasites and hosts) also determine patterns of abundance and therefore must be important in sustaining diversity. Yet there have been few studies on the effects of seawalls on ecological interactions among intertidal species.

The EICC is welcoming Dr Ljiljana Iveša for 6 months to work with Gee Chapman, Tony Underwood and Richard Murphy on this exciting new project, partially funded by a grant from the Sydney Aquarium Conservation Foundation. The project will focus on the interactions among three grazing limpets: *Siphonaria denticulata* and *Patelloida latistrigata* which are found in large densities on seawalls and *Cellana tramoserica*, which is larger, but only found in small densities on seawalls. Ljiljana will focus particularly on the effect of the material from which the seawall is constructed, on the development of algal food and the effect of limpet competition.

The project aims to look at whether differences in abundances of the limpets from place to place are due to the physical nature of the wall, to changes in food supply or to changes in the abundances of the other species on the seawall. The project will look at how competition develops between species that don't normally come into contact with each other on rocky shores, but are brought into close proximity on seawalls due to the constriction of the intertidal zone. The results of these studies will be used to predict the likely consequences to coastal biodiversity of increasing development of shorelines.

Gee Chapman, Professor of Marine Ecology
Hester Jackson, Seawalls Project Officer

Biodiversity Experiments at Kirribilli

Urban development continues to increase, but it is generally infrequent that ecologists get the opportunity to treat the developments as ecological experiments and investigate the accompanying ecological effects. The EICC is fortunate in being able to work with local councils willing and pleased to co-operate with our research.

In collaboration with North Sydney Council, a successful experiment in increasing the biodiversity of seawalls was done at Kirribilli. The sandstone seawall needed repair as wave-action had removed much of the mortar between the blocks and the soil was collapsing behind the wall. The decision was taken to repair the wall by resealing the joints with mortar. Although this didn't allow scope to modify the structure of the wall, it did allow the depth of the mortar between the blocks to be altered, to provide narrow crevices that might provide habitat for small gastropods, chitons and sessile species such as sponges, bryozoans and cnidarians.

Two adjacent 20m areas of the wall to be repaired were chosen. Each section was divided into 4x5m areas. Two of the four areas were repaired with the mortar flush, as originally planned. The other 2 areas had the mortar indented to provide crevices 2 cm deep and 3-5 cm wide. The sites of flushed and indented repairs alternated

A Crevice in a Seawall

along the wall, the pattern reversing between the two areas, as one end of the wall was more wave-exposed than the other. The repairs to the second area were carried out a month after the first area to allow temporal variability to be investigated too.

The crevices were found to increase the diversity of algae and sessile animals, but not mobile animals. It is likely that the increased diversity is due to the fact that the crevices ameliorated harsh conditions during low tide.

Hester Jackson, Seawalls Project Officer

A Linkage Project funded by the Australian Research Council

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University of Sydney

NSW Department of Primary Industries (Fisheries)

BIO-ANALYSIS: Marine, Estuarine & Freshwater Ecology

NSW Department of Environment and Climate Change

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Understanding the effect of Rain on Seawalls

With global climatic change an important issue of public concern, understanding the impacts of possible changes to weather patterns is needed. For some parts of the world, it is predicted there will be an increase in the frequency of storms and periods of rain. Rain can affect marine life in two ways: (1) the rain itself and (2) run-off as a result of large volumes of rain. The majority of studies have investigated the effects of the introduction of pollutants and large-volumes of freshwater associated with run-off. Few studies have, however, investigated the effect of actual rainfall on marine systems.

The seawalls in Sydney Harbour have many different types of microhabitats which may provide refuges from harsh environmental conditions. These include crevices formed between individual blocks of the sandstone walls and habitats made by algae and other sessile organisms (e.g. beds of oysters and mats of coralline algal turf) on the face of the wall. Many small mobile animals including crustaceans, bristle worms and snails, are able to change their behaviour in response to rain and may move to shelter in these habitats.

Rainfall varies in its intensity and duration in space and time, making comparisons between times when it is raining and when it is not raining difficult to interpret. Consequently, the effects on mobile marine animals on seawalls are also variable in space and time. Manipulative experiments, such as artificially creating rain on patches of seawall, help resolve such inconsistencies. Our experiments with artificial rain indicated that rain has a negative effect on abundances of crustaceans in coralline turf. When patches of coralline turf were subjected to artificial rain, crustaceans were seen to move out of these patches and into the water-column. Snails also show behavioural responses to natural rain, such that there are fewer limpets in beds of oysters and on the bare wall in periods of rain than when it is not raining. In contrast, when artificial rain was applied to limpets, they did not move, but clamped down onto the rock.

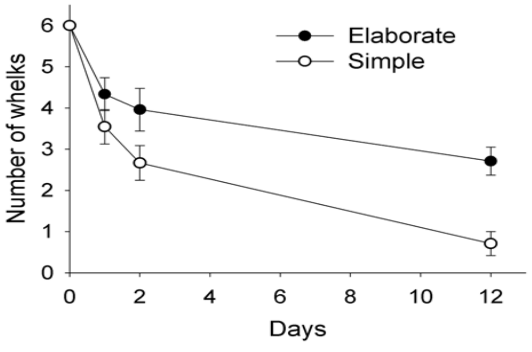
Short periods of rain, with minimal run-off, can thus have an effect on intertidal organisms. Manipulative experiments are important for understanding complex weather conditions. Furthermore, understanding how animals respond to different weather conditions will be important in gaining a predictive understanding for consequences of global climatic change.

Dr Victoria Cole and Dr David Blockley, EICC Post Doctoral Research Fellows

Ecological Engineering by Oysters on Seawalls

A popular concept in ecology is that some species, called ecological engineers, alter resources for other species. Often it is the actual structure of the engineers that influences other species. In urbanized estuaries, seawalls are becoming increasingly prevalent and oysters are often abundant on such seawalls. Oysters often act as engineers, altering habitat for other species, for example, by providing shelter from predation or inclement conditions. I have been studying how oysters on seawalls influence the abundance of a predatory whelk. These whelks are common on natural rocky shores, but are sparse on many seawalls.

On seawalls, crusts of oysters appeared to have different structures: in some places they seemed simple but in others, they seemed to be much more elaborate. Measurements of the structure of these types of crust showed that they were actually different. A survey of whelks on seawalls showed that they were common only in some places with elaborate crusts of oysters and were sparse everywhere else. This raised the question of why they could live in some places, but not others.



Morula disperse more rapidly from structurally simple crusts than they do from elaborate crusts of oysters.

The numbers of whelks could be greater on some seawalls because of the elaborate structure of the oysters or because of some other feature of those seawalls that also causes oysters to grow in elaborate crusts. To determine which was important, I did an experiment at six seawalls, manipulating oyster crusts to be elaborate or simple, to investigate how whelks respond to the different habitat (see diagram).

Whelks dispersed more rapidly from simple crusts, suggesting that conditions in this habitat may be unfavourable when compared with elaborate crusts. Differences in dispersal among habitats may explain the differences in numbers of whelks on seawalls with different types of crust. Simple oyster crusts may not provide sufficient shelter from impacts such as boat wash or heat stress. Experiments to measure the survival of whelks in oyster crusts are on-going.

This study demonstrated that the structures of oyster crusts only engineer habitat for whelks on some seawalls but not others. It has also allowed us to understand better the distribution of an important intertidal predator on artificial habitats in Sydney Harbour.

Angus Jackson, EICC Post Doctoral Research Fellow