Building Biodiversity

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BUILDING SEAWALLS TO SUSTAIN INTERTIDAL BIODIVERSITY IN ALTERED AND URBANIZED ESTUARIES

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Centre for Research on Ecological Impacts of Coastal Cities
University of Sydney

NSW Department of Primary Industries (Fisheries)

BIO-ANALYSIS: Marine, Estuarine & Freshwater Ecology

NSW Department of Environment and Conservation

NSW Maritime

NSW Department of Natural Resources

Sydney Ports Corporation

Hornsby Shire Council

Mosman Municipal Council

North Sydney Council

Wyong Shire Council

Contact:

Prof. M.G. Chapman
Centre for Research on Ecological Impacts of Coastal Cities

(02) 9351 4778

Email:
gee@eicc.bio.usyd.edu.au

Experimental Seawalls

We have started work at Tuggerah Lakes on a project aimed at identifying the effect of building seawalls on adjacent muddy sediments. Tuggerah Lakes is an important area for tourism, recreation and fisheries. Urban development is increasing, particularly along the lake fronts. Some areas in coastal lakes are protected from erosion by seawalls, but this has led to the build up of seagrass wrack and macroalgae at these locations. Decaying seagrass smells unpleasant and is a nuisance for those living or using the estuary nearby.

The project aims to sample an area for 6 months to identify the existing conditions. Dr Danny Roberts and his team from BIO-ANALYSIS: Marine, Esutarine and Freshwater Ecology will look at the seagrass, EICC will look at the organisms living in the sediments and Dr Peter Scanes and his team from the Department of Conservation will be using micro-probes to look at the soil chemistry and processes in the area. Following the six months of background sampling, Wyong Council will build wooden fences in the area to mimic seawalls. Sampling will continue to determine what impact the seawalls have on the area and then once they are removed, the recovery of the area will be measured.

This is an exciting project, that wouldn't have been possible without the commitment and enthusiasm of staff at Wyong Shire Council, in particular Sian Fawcett and Greg White. The members of EICC involved in the project are looking forward to working closely with their colleagues from BIO-ANALYSIS and the Department of Conservation on this innovative new research. The results of these studies should help councils, like Wyong Shire, who are responsible for the management of coastal lakes, to continue to care for these resources using the most up-to-date knowledge available to meet and adapt the objectives of their management plans.

GEE CHAPMAN
PROFESSOR OF MARINE ECOLOGY AND DEPUTY DIRECTOR

Outfalls in Sydney Harbour

Urban developments along the coastline have extensive drainage networks for stormwater, sewage, domestic and industrial waste. In Sydney Harbour, much of the coastline is artificial sandstone seawalls, where the drainage networks reach the sea in the form of outfalls. My Honours project looked at the effect of these outfalls on the marine organisms living on the seawalls.

Oysters and algae growth beneath a diverted outfall

I looked at the distribution and abundance of gastropods (mainly limpets), oysters and algae. There were fewer limpets, a smaller proportional cover of oysters and a larger proportional cover of green algae beneath outfalls than on adjacent areas of sea walls.

To test that the outfalls caused these patterns, I diverted the effluent. This had a small effect on the gastropods and caused algae to grow in the areas to which the effluent was diverted. I also found that adding moisture or removing gastropods from the outfall areas had no effect on the proportional cover of green algae. I did experiments to determine the processes that affect the numbers of limpets (*Patelloida mimula*) beneath outfalls. Mortality had a greater impact on numbers than limpets moving away from the outfall. Whether this was due to the physical effect of the effluent preventing the gastropods attaching securely to the seawall or the reduced salinity of the effluent compared to seawater causing harm to the gastropods, is a subject for future experiments. Limpets occur more frequently on oysters than on bare rock on seawalls in Sydney Harbour. Further experiments showed that substratum – bare rock or oysters – did not affect the mortality rates of the limpets, but that they moved away from bare rock to oysters. There are fewer oysters beneath the outfalls than elsewhere.

This research can be used to guide the future location of outfalls associated with urban development to minimize their potential negative impacts on the marine intertidal environment.

ADAM REESON, HONOURS STUDENT AT EICC

Investigating Seagrass Wrack

Human disturbance can dramatically alter estuaries. Their shorelines are often highly urbanized and subject to a large degree of pressure from development and land-use activities. Sometimes the habitat is changed to the point that its structure and ecology are affected.

Seagrasses are important because their high productivity provides food, while their complex structure is habitat for fish and invertebrates. Seagrass meadows and macro-algae are often found in shallow coastal waters and are therefore exposed to a large degree of disturbance. If macro-algae form algal blooms (for example through increased levels of nutrients from human activities) they can become a serious problem for the habitat. The Tuggerah Lakes estuary (Central Coast, NSW, Australia) is no exception, with areas that have seen considerable urban development and hence an increase in nutrients. The resulting environmental impacts are, however, not well understood.

When seagrass dies it detaches from the bottom and forms what is known as wrack. This is often mixed with algae and forms thick mats that either sink, or float on the surface of the water. The breakdown of seagrasses and macro-algae is important for nutrient cycling and productivity. In estuarine environments it results in fragments of plant material, which in turn are an important source of food for other organisms. Wrack can, however, also 'smother' and hence damage living seagrass and related animals.

Shoreline at Tuggerah Bay

Tuggerah Bay and Chittaway Bay are two embayments of the Tuggerah Lakes. The former is mostly undeveloped, while the latter is developed with residential housing built along most of its foreshore. Development is reported to increase wrack, which is a serious ecological, social and economic issue in the Tuggerah Lakes, where large beds of floating wrack accumulate on the surface of the water and on the shores. It is therefore critical to understand how dead plant material breaks down, to what extent it affects the ecology of the estuary and how it is affected by shoreline development.

I have found that the densest beds of wrack generally occurred at the shore-lake inter-face, while living seagrass mainly occurred further away from the shore. The distribution of seagrass in the embayments did not show any particular pattern with either distance from shore, or among different bays. At most sites wrack was more abundant than living seagrass. Wrack was mainly made up of *Zostera capricorni*, although this species was generally scarce among the living seagrass. On the contrary, other species of seagrass (*Halophila ovalis* and *Ruppia megacarpa*) were represented more in the living seagrass than in the wrack.

My research will add to the understanding of key processes in the Tuggerah lakes, and how the functioning of seagrass meadows is affected by increasing human activities. This information will be invaluable to local Councils for the management of urbanized estuaries.

Giordana Cocco
PhD Student

Impact of wharves on animals and algae living on seawalls

Wharf and Seawall at Rose Bay

The urbanisation of Sydney's foreshores has resulted in large areas of natural shore being replaced by artificial structures, most commonly seawalls. These seawalls do not, however, exist in isolation and are often associated with other urban structures. There are a large number of boats using Sydney Harbour, requiring infrastructure to support them and so one of the most common structures associated with seawalls are wharves and jetties.

Despite being artificial, seawalls provide habitats for many marine organisms. The presence of wharves over part of seawalls may modify the environmental conditions on the seawall, e.g. amount of light and surface temperature of the rock, and this may in turn may affect the animals and algae living on the seawall. This was assessed at various locations throughout the harbour. There were differences between what was living on seawalls that were underneath wharves compared to seawalls in the open. Specifically, more algae and marine snails were on seawalls that were not under a wharf, while there were more sessile invertebrates (e.g. oysters and mussels) on walls under wharves.

Many of the patterns of distribution of marine organisms are determined at the time they recruit into a habitat, i.e. when the larvae or propagules settle out of the water column and attach to a surface. Further research showed that many of the patterns of difference on seawalls under or not under wharves was determined by differences in recruitment between these two habitats. This indicates that recruitment is important in determining patterns of distribution on seawalls for some organisms and that this is affected by the presence of a wharf over a seawall.

This research shows that when assessing potential impacts of artificial structures they cannot be considered in isolation, but must include potential cumulative affects of other structures in their vicinity. This also shows that environmental conditions of artificial structures can be modified by nearby structures and that these changes result in changes to the assemblages of organisms living on them. This is important when considering the types of organisms living on otherwise homogeneous structures that only support a fraction of the types of organisms found on natural shores.

David Blockley
Research Fellow