

# Proposed Projects for Biodiversity Enhancement of Artificial Coastal Defence Structures

by

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## Background

In recent years there has been much interest in ecologically sensitive design of artificial coastal structures in urban environments. Environmental heterogeneity provides a diversity of resources and microhabitats underpinning coexistence of competitors, which would not be possible in homogenous environments and is therefore an important mechanism in the maintenance of biological diversity at a range of spatial scales. On a micro-scale, geology and surface roughness are known to have a significant effect on the structure and functioning of the colonizing assemblages whilst on small to medium scales, crevices, pits and rock pools provide important refuges for many species.

Ecological engineering is a relatively new concept which integrates ecological, economic and social needs into the design of man-made ecosystems. The creation of novel habitats can have a positive effect on biodiversity on artificial coastal defence structures. Borsje et al. (2011) incorporated modifications (surface roughness, grooves and pits) to concrete blocks at different tidal heights (low, mid, high) on the breakwaters at the entrance to the North Sea Channel at IJmuiden, the Netherlands. All sections of the slabs in the mid and low tidal zone were rapidly colonised by invasive non-native barnacles (*Austrominius modestus*). Mussels (*Mytilus edulis*) were only found in the sections with grooves and holes, and developed best within the grooves (Borsje et al. 2011). Both grooves and holes were used as refugia from adverse environmental conditions by periwinkles (*Littorina littorea*) during low tide. Also, slabs which were mounted low in the intertidal area showed a more rapid and diverse colonisation, compared to the slabs which were mounted higher in the intertidal zone. Thompson et al. (unpublished, cited in Witt et al. 2010) attached tiles (which had been drilled with holes of differing diameters) to a coastal defence structure in SW England. The addition of habitat complexity to concrete surfaces resulted in significantly increased diversity of intertidal organisms within five months.

Chapman and Blockley (2009) demonstrated that creating artificial “rock-pools” into a vertical seawall significantly increased the diversity of species colonising the wall. This was achieved very simply by omitting a large block every now and then. This was replaced with a sandstone lip, which created a pool that retained water during low tide. Diversity was increased both by the pool environment and the creation of shaded surfaces. Modifications like this one are very effective when they can be incorporated at the construction stage, but Chapman and colleagues came up with a novel solution to enable the incorporation of artificial rock pools into existing seawalls. Browne & Chapman (2011) affixed specially designed flowerpots that were affixed to seawalls in Sydney Harbour. The pots were cast in such a way that they retained water during low tide, thus creating an artificial rock pool. The addition of these novel habitats increased species richness by 110%. Importantly, the increased number of mobile species was particularly pronounced with many species that were not normally able to survive on the vertical faces of seawalls.

## Project 1 – Baseline surveys: Habitat mapping and biodiversity surveys

Much of the coastline in the immediate are of Galway City is artificial (seawalls, rock armour, groynes, harbour, docks, pier, steps, etc....). It is important to establish the identify the extent of both natural and artificial intertidal habitat in the Galway City Coastal Zone. A combination of quantitative and semi quantitative surveys will yield valuable information about the biodiversity associated with both natural and artificial habitats. This could involve a combination of surveys of epibiota, infauna, birds, mobile species, and invasive non-native species.

I see this as a project that could be implemented in the short term and could happen over the next 12-18 months.

### **Project 2 – Habitat enhancement on Mutton Island Causeway**

The concrete units on Mutton Island Causeway represent a unique, cheap, safe and easy opportunity for habitat enhancement. The units conveniently have circular gaps on all 6 sides (including the base). It would be very easy to create artificial rock pools in the bases of a number of these units by filling them up with concrete such that they retain water – mimicking natural rock pools.

Pools could be created at different tidal heights as the units are very conveniently placed in neat rows. This would enable the testing of hypotheses about the effect of tidal height on colonizing biodiversity. Furthermore, pools could be created on both the exposed (west-facing) and sheltered (east-facing) sides of the causeway. This would enable the testing of hypotheses about the effect of exposure on colonizing biodiversity.

I see this as a project that could be implemented in the short term and pools could be created within 6 months. Monitoring of colonization of the pools would happen over much longer time scales.

### **Project 3 – Habitat enhancement on the new Galway City Docks**

There are plans to redevelop the Galway City Docks over the coming years. This creates a unique and timely opportunity to get engineers, managers and ecologists to have discussions about the possibilities of habitat enhancement in various components of the redevelopment (e.g. new breakwater, rock revetments, marina, sea walls etc...). The incorporation of enhancements at the construction phase rather than retrospectively enables a much wider scope of possibilities. I propose that it is possible to incorporate a combination of different habitat types in the different components which will be monitored in the long term.

I see this as a long-term project that would only be able to happen as and when the different phases of the development happen.

### **Linkage with Galway City Council Biodiversity Action Plan**

#### *1. To raise awareness and appreciation of biodiversity*

Project 1 could involve public engagement through bio blitzes, a website and leaflets. I personally would not have time to manage a website and do a large number of public events, but by liaising with volunteer and conservations groups, it would be very possible to actively involve the public and raise awareness and appreciation of coastal biodiversity.

The installation of the habitat enhancements, particularly the BIOBLOCK could be made a public event. It is possible to make the BIOBLOCKS an art installation. Given the rich cultural and arts heritage in Galway, it might be possible to liaise with the city arts council for such an event.

#### *2. To maintain and enhance biodiversity within the city*

The installation of habitat enhancement measures will contribute to the maintenance and enhancement of biodiversity within the city.

#### *3. To increase our knowledge and understanding of biodiversity*

The combination of biodiversity surveys and placement of enhancements at in a range of different environmental conditions will significantly increase our knowledge and understanding of biodiversity, not just in Galway City but in urban coastal environments worldwide.

### **Literature cited**

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