BIODIVERSITY BENEFITS OF SCALING UP MARINE ECO-ENGINEERING

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Marine construction is a growing source of biodiversity loss in our oceans. As of 2018, marine constructions, including coastal defenses, offshore energy, oil and gas structures, and aquaculture facilities modified more seafloor globally than is occupied by mangrove forests and seagrass beds (Bugnot et al. 2021). A further 70% increase in their number is expected over the next decade as sea level rise triggers new artificial coastal defenses, and the blue economy expands (Bugnot et al. 2021).

The ecological impacts of marine constructions arise both from their destruction and degradation of natural habitats, but also their flat and often featureless surfaces, which provide little protection to marine life from predation and environmental stressors (Bulleri, Chapman 2010; Airoldi et al. 2005). The net effect is loss of native biodiversity, and spread of pest species. Marine "eco-engineering" seeks to mitigate some of these impacts by co-designing marine constructions for humans and nature (Chapman et al. 2018).

Small-scale experiments indicate benefits to biodiversity of adding complex surface geometries to marine built structures (Strain et al. 2018, 2020). However, there are few examples where habitat complexity has been added to marine constructions at scale. We assessed the biodiversity benefits of adding habitat complexity to seawalls at scales of tens of meters, We also compared the efficacy of different types of habitat complexity in benefiting biodiversity.

Figure 1 – The study site, approximately 6 months following panel installation (Photo credit: Alex Goad)

A 12m-long stretch of intertidal seawall in Sydney Harbour was retro-fitted with habitat enhancing 'Living Seawalls' panels in October 2018 (Fig. 1). The panels were 550 mm in diameter, had a roughly hexagonal interlocking shape and were fabricated of 40 MPa eco-blend concrete, with structural polypropylene fibres and composite reinforcement. Four complex panel designs were deployed, mimicking crevices, honeycomb weathering, rockpools, and fish swim throughs, as well as a flat control (Fig. 2; Bishop et al, 2022). Panels were fitted to walls using stainless rods, such that they sat ~100 mm off the surface of the existing wall, removing the need to clear existing growth.

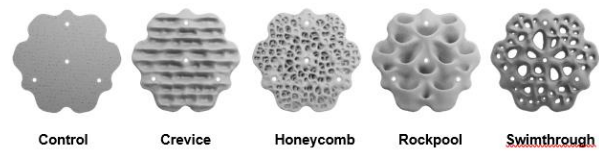

Figure 2 – The five panel designs utilized in the study

By two years following installation, 115 different species had already colonised the Living Seawall – a comparable number to that found on natural rocky shores. Complex panels supported up to 264% more species than flat, control, panels (Fig. 3), with each design supporting distinct ecological communities. The species enhanced by Living Seawalls included oysters that improve water quality through filtration, kelp that sequesters carbon, and fish species targeted by recreational fishers.

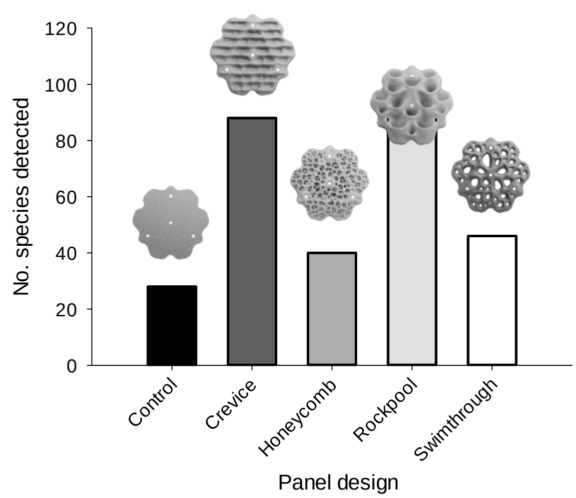

Figure 3 - The total number of species detected on each of the five panel designs, at a mid-intertidal elevation, over the 24 month study

These results highlight the promise of large-scale seawall eco-engineering in mitigating some of the negative effects of coastal structures on biodiversity. The results also illustrate the benefits to biodiversity of providing multiple types of intervention at the one site.

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