Artificial coastal defences could be used to enhance marine biodiversity, study shows

August 10 2017

Future coastal defences, harbours and ports could enhance biodiversity within the marine environment through the use of cement substitutes. But the materials used need to be selected carefully in order that native and non-native species are not adversely affected, a study by the University of Plymouth suggests.

With the pressures of climate change and many of the world's population living on or near the coast, there is growing demand to increase development of the marine and coastal environment.

Many schemes already use cement replacements, but with them being introduced on a larger scale, there is a pressing need to determine their effect on the organisms which colonise them and the wider marine environment.

Scientists from the University conducted a series of tests over a two-month period and said some of these alternative materials appeared to have a negative effect on colonising native species but had no effect on non-native species.

The study, published in *Ecological Engineering*, is one of the first to combine chemical leaching and biological data regarding the use of artificial materials within coastal and marine infrastructure.

Lecturer in Environmental Science Dr Louise Firth, the study's corresponding author, said: "As cement production is so energetically

costly to produce, the construction industry is now investigating cement replacements using waste materials. Our work has shown that native and non-native species have contrasting responses to different waste material cement replacements. This highlights that much more research is needed in this area to assess the full environmental impact of such practices before adopting cement replacements in the marine construction industry ."

For the study, scientists placed tiles made using cement as well as varying quantities of two widely used substitutes – pulverised fly ash (PFA) and ground granulated blast-furnace slag (GGBS) – at waterfront locations in Plymouth.

They then monitored them for a period of seven weeks, assessing the quantity of chemicals from the tiles that leached into the marine environment but also the effects on colonising biofilms and macro-algae.

The results showed that cement replacement materials leached different metal concentrations: PFA was higher overall and GGBS was lower overall.

It also showed that there was an impact on colonising species. Whilst there was no significant difference in biofilm percentage cover or non-native species richness between treatments, it was found that treatments containing GGBS had lower native species richness than the control treatment (that had no cement replacements).

This study is the latest in which academics from Plymouth have explored the impact of coastal infrastructure on the marine environment. The University is also one of the partners in the World Harbour Project, which is seeking to develop resilient urban ports and harbours globally.

Dr Firth added: "The biodiversity associated with sea defences may have

beneficial effects, such as habitat provision, water filtration and even strengthening the structures. However, the results presented here highlight the fact that differences in concrete composition can have significant effects on the biodiversity of subtidal fouling organisms that colonise artificial surfaces. This information could be used in future to help design features that enhance biodiversity and the ecosystem services this provides at little or no extra cost."

More information: Ryan S. McManus et al. Partial replacement of cement for waste aggregates in concrete coastal and marine infrastructure: A foundation for ecological enhancement?, *Ecological Engineering* (2017). DOI: 10.1016/j.ecoleng.2017.06.062

Provided by University of Plymouth